Implementation of an Attention Training Program with Children who have sustained Traumatic Brain Injuries in South Africa

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Declaration

I hereby declare that this submission is my own work, both in concept and execution, and that to the best of my knowledge and belief it contains no material written by another person nor material that has been accepted for an award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text.

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Talia Haidee Lanesman (Ms) Date

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Abbreviations

ABAS	Adaptive Behaviour Assessment System
ABI	Acquired brain injury
ADHD	Attention Deficit Hyperactive Disorder
AIM	Attention Improvement Management
AMAT-c	Amsterdam Memory and Attention Training for Children
ANT	Amsterdam Neuropsychological Tasks
APT	Attention Process Training
BASC	Behaviour Assessment System for Children
BRIEF	Behaviour Rating Inventory of Executive Function
CARE	Children's Assessment of Recreation and Enjoyment
CBCL	Child Behaviour Checklist
CMS	Children's Memory Scale
CP	Cerebral palsy
CPT-II	Conners' Continuous Performance Test - Second Edition
CRT	Cognitive Rehabilitation Therapy
CT	Completion time
DAI	Diffuse axonal injury
DCAP	Division of Child and Adolescent Psychiatry
DKEFS	Delis-Kaplan Executive Function System
DL	Dot Locations
DT	Dual Task
DSM-5	Diagnostic and Statistical Manual of Mental Disorders-5th edition
F	Females
FASD	Fetal Alcohol Spectrum Disorder
FHS	Faculty of Health Sciences
FSIQ	Full scale IQ
GAS	Goal Attainment Scaling
GCS	Glasgow Coma Scale
GDS	Gordon Diagnostics System
HI	Head injury
HIC	High-income country
HIV	Human Immunodeficiency Virus

HPCSA	Health Professions Council of South Africa
INI	Inhibition-Inhibition
INN	Inhibition-Naming
ISI	Inter-stimulus interval
LAMIC	Low- and middle-income country
LOC	Loss of consciousness
LSEN	Learners with Special Educational Needs
M	Males
MD	Missing data
MVA	Motor vehicle accident
NEPSY	Developmental NEuroPSYchological Assessment
NEPSY-II	Developmental NEuroPSYchological Assessment – Second Edition
ODD	Oppositional Defiance Disorder
OMQ-PF	Observer Memory Questionnaire – Parent Form
P-ADHD	Primary Attention Deficit Hyperactive Disorder
PIQ	Performance IQ
PTA	Posttraumatic amnesia
pTBI	Pediatric traumatic brain injury
PQL	Pediatric Quality of Life
RA	Research assistant
RAVLT	Rey Auditory Verbal Learning Test
RBMT	Rivermead Behavioural Memory Test
RCI	Reliable Change Index
ROCF	Rey-Osterrieth Complex Figure
RT	Reaction time
RXH	Red Cross War Memorial Children's Hospital
S-ADHD	Secondary Attention Deficit Hyperactive Disorder
SD	Standard deviation
SE	Standard error
SES	Socio-economic status
SS	Scaled score
TBI	Traumatic brain injury
TEA-Ch	Test of Everyday Attention for Children
UCT	University of Cape Town

US	United States of America
VABS	Vineland Adaptive Behaviour Scales
VABS-II	Vineland Adaptive Behaviour Scales – Second Edition
VIQ	Verbal IQ
WAIS-R	Wechsler Adult Intelligence Scale – Revised
WASI	Wechsler Abbreviated Scale of Intelligence
WCED	Western Cape Education Department
WIAT-II	Wechsler Individual Achievement Test – Second Edition
WISC-III	Wechsler Intelligence Scale for Children – Third Edition
WISC-IV	Wechsler Intelligence Scale for Children
WISC-R	Wechsler Intelligence Scale for Children – Revised
WL	Word list

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Abstract

Traumatic brain injury (TBI) is an international public health concern, particularly in low- and middle-income countries. Children who sustain TBIs typically have attentional difficulties, which disrupt the development and functioning of other cognitive, behavioural, and social skills. The aim of this research was to evaluate the efficacy and feasibility of implementing an attention-training program for children who have sustained moderate-to-severe TBI in South Africa, and to compare the efficacy of the program in two clinical samples: children with TBI and children with Attention Deficit Hyperactivity Disorder (ADHD). Fifteen children aged 6 to 8 who sustained TBIs at least a year before were recruited to form three groups: a TBI Intervention Group (n = 5), a TBI Art Group (n = 5) and a TBI Control Group (n = 5). Five children who had been diagnosed with ADHD formed the ADHD Intervention Group. Children in the two Intervention Groups participated in the 'Pay Attention!' program (originally designed to assist children with ADHD) for 45 minutes twice a week for 12 weeks. All children underwent neuropsychological testing pre- and post-intervention and behavioural data was collected from parents and teachers. Between- and within-group analyses showed that children in the TBI Intervention group did not show overall significant improvements in attention. However, children in the ADHD Intervention Group showed individual attentional improvements on measures of the CPT-II, as well as secondary gains in verbal memory. Nevertheless, implementing a cognitive rehabilitation intervention in South Africa is feasible and necessary, despite limited infrastructure and access to resources. Further research is required to better tailor interventions to the needs of children with TBIs.

Keywords: pediatric traumatic brain injury, cognitive rehabilitation, attention training, South Africa, 'Pay Attention!'

Introduction

Traumatic brain injury (TBI) is an international public health concern with significant socio-economic sequelae, affecting over 10 million people per year (Hyder, Wunderlich, Puvanachandra, Gururaj, & Kobusingye 2007; Roozenbeek, Maas, & Menon, 2013). Although there have been no recent local incidence statistics published in low- and middle-income countries (LAMICs) such as South Africa, researchers purport that the incidence rates, severity of injury and related morbidity and mortality are substantially higher compared to high-income countries (HICs; Corrigan, Selassie, & Orman, 2010; Hyder et al., 2007; Schrieff, Thomas, Dollman, Rohlwink & Figaji, 2013). The primary reason for the higher incidence rates of TBI in South Africa is that the country has one of the highest motor vehicle accident (MVA) rates internationally (Hyder et al., 2007; Levin, 2004).

When a TBI occurs during childhood, the injury can disrupt the acquisition of developmental skills and milestones, which have serious long-term sequelae (Anderson, Northam, Hendy & Wrennall, 2001b). Although many argue that neural plasticity can allow the developing brain to overcome the trauma sustained, TBI is also likely to put the ability to attend to and consolidate knowledge at risk, which will result in pervasive difficulties (Anderson, Spencer-Smith & Wood, 2011). Attention difficulties in particular, which are one of the most common sequelae post-TBI, may underlie children's emotional, academic and behavioural difficulties post-injury (Anderson et al., 2001b; Anderson, Catroppa, Morse, Haritou, & Rosenfeld, 2005; van't Hooft, 2005; van' Hooft, Andersson, Sejersen, Bartfai, & von Wendt, 2003; Yeates et al., 2005). Because attention is a basic function upon which other learning is built, an effective rehabilitation program focused on remediating attention could have far-reaching positive implications in terms of the child's development and recovery post-TBI (Anderson et al., 2001b).

'Pay Attention!' (Thomson, Kerns, Seidenstrang, Sohlberg, & Mateer, 2005), a cognitive rehabilitation program for children, has been used successfully in improving attention in children diagnosed with Attentional Deficit Hyperactive Disorder (ADHD). Children with TBI are susceptible to a comorbid diagnosis of ADHD, which is termed secondary ADHD (S-ADHD), or may have the inattentive symptoms of ADHD post-injury (Max et al., 2005). In a recent unpublished study, 'Pay Attention!' was implemented with children following severe TBI in South Africa. Results showed reliable change in one of four participants, specifically in the domain of inhibition (Schrieff, 2013).

The aim of this research is to further investigate the efficacy of the 'Pay Attention!' program in South African children who have sustained moderate-to-severe TBI as the South

African and international literature in cognitive rehabilitation is limited and inconclusive (Laatsch et al., 2007; Levin, 2004; Limond & Leeke, 2005; Slomine & Locascio, 2009).

Definitions and Terminology

TBI. A TBI is a non-degenerative, non-congenital assault to the brain caused by an external mechanical force. The blunt or penetrating insult affects the level of consciousness and may cause temporary or permanent, cognitive, physical and/or psychosocial deficits (Anderson et al., 2001b; Tabish, Lone, Afzal, & Salam, 2006). TBIs cause a change in brain functioning, which can be seen by the resulting confusion, coma, seizures, or focal neurological deficits typically observed post-injury (Bruns & Hauser, 2003). It is this change in brain function that differentiates 'TBI' from the non-specific term 'head injury' (HI; Anderson et al., 2001b).

Head injury. A HI typically refers to external injuries of the bones or soft tissues of the face, scalp or skull and may not necessarily imply that damage to the brain has been sustained. Although the term HI is considered to be antiquated, the term has been used interchangeably with TBI in recent South African literature (Bruns & Hauser, 2003; Corrigan et al., 2010; du Toit-Prinsloo & Saayman, 2014).

Classification and pathophysiology of TBI. Classifying a TBI into various categories, aids in understanding the mechanisms of the injury, as well as in predicting the subsequent acute and long-term outcomes. TBIs may be classified as open vs. closed and there are both primary vs. secondary injuries. TBIs are also classified as mild, moderate, or severe. I discuss these classifications as well as the pathophysiology of TBI, below.

Open and closed TBIs. Open TBIs, also known as penetrating HIs, refer to a penetration of the skull by an object such as a knife or bullet. Cerebral pathology arises from tissue destroyed along the projectile path, or from shattered fragments of the penetrating object or skull entering neighboring tissue. Neuropsychological sequelae tend to be focal and specific, reflecting the localised nature of the lesion. A loss of consciousness (LOC) does not always occur (Anderson et al., 2001b; Osborn, 2013; Ponsford, 2013).

The majority of TBIs are closed injuries, which occur in high speed MVAs (Anderson et al., 2001b). In closed injuries, the primary injury does not result from penetration of the skull, but rather from the different types of biomechanical forces acting on the brain. Because the brain is viscoelastic in nature, it is particularly vulnerable to these forces that occur during an MVA, and the pathophysiological cascade that follows (Greve & Zink, 2009; Richardson, 2011; Zink, Szmydynger-Chodobska, & Chodobski, 2010).

Pathophysiology of TBI. In an MVA, the rotational and sudden acceleration and deceleration forces cause significant impact of the brain against the ridged skull and tough, fibrous dura, resulting in multiple injury sites, gyral contusion, and diffuse axonal injury (DAI; Anderson et al., 2001b; Granacher, 2008; Osborn, 2013). The initial forward acceleration can cause a coup injury where the posterior regions of the brain are forcibly impacted against the posterior plates of the skull. The compensatory contrecoup injury occurs during rapid deceleration, as the brain is knocked against the anterior plates of the skull. Rotational forces also tend to act on the brain, stretching and shearing white matter fibers, particularly in the subcortical areas and at the grey-white matter junction, resulting in DAI. Many of these injuries occur in predictable locations such as the temporal lobes particularly at the temporal poles, lateral and inferior surfaces of the perisylvian gyri, and orbital surfaces of the frontal lobes (Anderson et al., 2001b; Osborn, 2013; Margulies & Coats, 2013; Smith, Hicks, & Povlishock, 2013). A TBI thus involves an immediate primary injury that happens upon impact, followed by a series of secondary injuries.

Primary and secondary injuries. Primary injuries occur as a result of the mechanical forces acting on the brain at the time of the injury. Although the forces initiating the primary injury take less than 100 milliseconds to occur, the effects may not be patent on the first clinical evaluation (Greve & Zink, 2009; Osborn, 2013). Primary injuries include scalp, skull and facial injuries, extra-axial hemorrhages (e.g., acute epidural or subdural hematoma, traumatic subarachnoid hemorrhage), and parenchymal injuries (e.g., cerebral contusions and lacerations, diffuse axonal or vascular injury, subcortical injury; Anderson et al., 2001b; Osborn, 2013).

However, TBI is not an isolated event, as a cascade of pathophysiological events typically extends from the moment of injury until days, months, or years post-injury, causing a secondary injury. Secondary injuries are often more devastating than the primary injury, and include inflammation, apoptosis, herniation syndromes, edema, ischemia, vascular injury, and cerebrospinal fluid leaks. There is also a broad spectrum of post-traumatic encephalopathic syndromes that may manifest years or months after the initial injury (Greve & Zink, 2009; Osborn, 2013; Zink & McQuillan, 2005). These injuries are usually preventable or treatable (Anderson et al., 2001b).

Classification of severity. The duration of LOC, the duration of posttraumatic amnesia (PTA), and the Glasgow Coma Scale (GCS) score are considered to be the “gold standard” indicators of injury severity (Malec et al., 2007, p.1422). However, across studies, the GCS is most commonly used (Kirkwod & Yeates, 2010). A score out of 15 is given based

on eye opening (out of 4), motor response (out of 6) and verbal response (out of 5; Zink & McQuillan, 2005). Scores of 13-15 indicate a mild TBI, scores of 9-12 indicate a moderate injury and scores of 3-8 indicate a severe TBI has been sustained. The GCS score has been considered a good predictor of functional outcome post-injury (Kirkwod & Yeates, 2010; Lesko et al., 2013). Based on GCS, a systematic review of European literature found that approximately 70-80% of patients are classified as having mild injuries, 10% as moderate injuries and 10% as severe injuries (Tagliaferri, Compagnone, Korsic, Servadei, & Kraus, 2006). In the last South African epidemiological study, 88% of patients sustain mild injuries, 8% sustain moderate injuries, and 5% sustain severe injuries (Nell & Brown, 1991). Although these epidemiological statistics indicate that the minority of TBIs sustained are moderate or severe, the devastating sequelae of TBI are often overlooked, regardless of severity.

Epidemiology of TBI

TBI has been referred to as a "silent epidemic" in the literature for two primary reasons. Firstly, society is largely unaware of the extent of the burden, and secondly, the post-injury neuropsychological deficits and emotional effects are often not immediately apparent, or are not as obvious as the physical deficits (Anderson et al., 2001b; Langlois, Marr, & Johnson, 2005; Langlois & Sattin, 2005; Myburgh et al., 2008; Rutland-Brown, Langlois, Thomas, & Xi, 2006). TBI is however an international public health concern with a significant global impact (Hyder et al., 2007; Roozenbeek et al., 2013).

Worldwide incidence and prevalence. TBI is a primary cause of morbidity and disability around the world, affecting over 10 million people per year (Bener, Omar, Ahmad, Al-Mulla, & Abdul Rahman, 2010; Corrigan et al., 2010; Hyder et al., 2007; Sandler, Figaji, & Adelson, 2010). The most recent estimates indicate that every year in the United States, 1.7 million people sustain a TBI, 275 000 of whom are hospitalized and 52 000 of whom die (Faul, Xu, Wald, & Coronado, 2010). The prevalence of TBI related disability in the United States has been reported as 3.2 million (Zaloshnja, Miller, Langlois, & Selassie, 2008). In a meta-analysis of European epidemiological data, Tagliaferri and colleagues (2006) found the incidence rate to be 235/100 000, and the mortality rate to be 15/100 000. Prevalence data was not available.

However, worldwide, the quantification of the incidence and epidemiology of TBI is unreliable due to variability in the definition of TBI, the capturing of data with regards to incidence and post-injury outcome, and case ascertainment (Roozenbeek et al., 2013). In

addition, many individuals who have sustained a TBI do not seek treatment, particularly if they are older, if the injury was sustained at home, or if the injury sustained was mild (Setnik & Bazarian, 2007).

Nevertheless, the World Health Organization predicts that by 2020, TBI will be the primary cause of death and disability, surpassing all other diseases (Hyder et al., 2007). Even though evidence-based guidelines for the management of TBI have been introduced and have lead to improved outcome post-injury, studies still suggest that the overall mortality rate has not decreased since 1990 (Myburgh et al., 2008; Roozenbeek et al., 2013). However, some studies suggest that improved TBI care has led to a decrease in mortality, and subsequently a need for more long-term rehabilitation, in both LAMICs and HICs (Coronado et al., 2011; Hofman, Primack, Keush, & Hrynkow, 2005; Schrieff et al., 2013).

TBI in LAMICs compared to HICs. Although TBI is of major international concern, the incidence, prevalence and effects of TBIs are more prominent in LAMICs, compared to HICs (Hofman et al., 2005). Causes of TBI such as violence resulting from political unrest, as well as MVAs, are more apparent in developing countries, where there is also a lack of resources, infrastructure, emergency services and intensive care unit availability in order to treat patients and avoid secondary injuries. Many individuals have also had poor access to education leading to an unawareness of safety regimens, and thus prevention of injury. Particularly in Africa, access to health care services is poor, meaning that many mild TBI cases go unreported and untreated, and the more severe cases die on the way to the hospital (Alexander et al., 2009; Harris et al., 2008; Levin, 2006). In LAMICs such as those in Sub-Saharan Africa, 150 - 170 people per 100 000 people reportedly sustain a TBI annually, which is raised compared to the 106/100 000 global incidence rate (Hyder et al., 2007). Therefore, a greater research focus on TBIs, particularly of the moderate to severe nature, is needed in LAMICs such as South Africa.

Economic burden. The annual economic cost of TBI in the United States, including direct medical and rehabilitation costs and indirect societal economic costs, was previously estimated to be $US 406 billion[1] (Corso, Finkelstein, Miller, Fiebelkorn & Zaloshnja, 2006), of which at least $US 1 billion[2] is due to pediatric TBIs (pTBIs; Shneier, Shields, Hostetler, Xiang & Smith, 2006). A conservative estimate of life time estimate costs of severe TBI per

[1] At the time of the current study, the Rand equivalent was approximately R4 470 billion.
[2] At the time of the current study, the Rand equivalent was approximately R11 billion.

individual is $US 396 331[3], accounting for expenditures related to long-term disability, loss of productivity, as well as medical care and rehabilitation (Faul, Wald, Rutland-Brown, Sullivent, & Sattin, 2007).

In a 10 year follow-up study on 1 237 TBI patients in Australia, it was found that the majority of TBI-related costs are due to long-term care costs, followed by hospital, paramedical, and medical costs. Factors associated with long-term costs include duration of PTA, GCS score, longer acute hospital stay, abnormal computed tomography scan, epilepsy occurring early post-injury, lower education, pre-injury unemployment, and living outside the city (Ponsford, Spitz, Cromarty, Gifford, & Attwood, 2013). In children who have sustained TBI, the economic burden is likely to be elevated compared to adults, as the injury may lead to life-long disability, rehabilitation, and loss of work productivity from an early age (American Academy of Pediatrics, & Pediatric Orthopedic Society of North America, 2008).

Pediatric TBI

TBI is one of the most common causes of acquired disability in childhood. Compared to adults, children are more sensitive to factors that affect the causes and related sequelae of TBI, as well as factors that influence recovery and post-injury outcome.

Incidence and prevalence. As with adults, TBI is considered to be the leading cause of death and disability for children and adolescents (Bener et al., 2010; CDC, 2000; Kumar & Mahapatra, 2009; Myburgh et al., 2008). In America, almost half a million (473,947) emergency department visits for TBI are made annually by children aged 0 to 14 years, with population estimates ranging from 200-500 per 100 000 TBI cases a year (Anderson & Yeates, 2010; Faul et al., 2010). Although specific incidence comparisons are unavailable, many authors suggest that more childhood injuries and pTBIs occur in LAMICs compared to HICs (Bartlett, 2002; Murgio, Fernandez Milà, Manolio, Maurel & Ubeda, 1999).

Cywes et al. (1990) reported that in South Africa, HIs were the most common cause for admission to hospital in children younger than 13. At the Red Cross War Memorial Children's Hospital (RXH) in Cape Town, South Africa, 9% of children treated in the trauma unit between 1991 and 2001, were identified as having a TBI (Lalloo & van As, 2004). Between 2006 and 2011, 137 children who sustained severe TBI and who required intracranial monitoring were admitted to the RXH (Schrieff et al., 2013). The mortality rate for this sample was 14.6% (Schrieff et al., 2013).

Although the above-mentioned studies provide a snapshot of the problem of pTBI in

[3] At the time of the current study, the Rand equivalent was approximately R4 million.

South Africa, actual incidence rates are not available. Due to the history of violence in apartheid, the resulting income disparities, resource inequalities, inflated levels of crime and violence, as well as increased MVAs compared to HICs, South Africa's epidemiological statistics for TBI are likely to be higher compared to more developed countries (Hyder et al., 2007; Levin, 2004).

Causes of injury. The common causes and hence the nature of pTBI varies according to demographics (e.g. age and sex), context (e.g. socio-economic and psychosocial factors) and developmental stage (Anderson et al., 2001b; Anderson & Yeates, 2010; Bruns & Hauser, 2003; Cassidy et al., 2004; Myburgh et al., 2008). For example, injuries resulting from abuse are more likely to occur in infants, and injuries resulting from falls are more likely to occur among infants and preschool children. These types of early injuries tend to be directly linked to environmental factors such as social disadvantage and family dysfunction. In older children, injuries tend to be associated with the child's own agency and behaviour, and are typically a result of MVAs or sport accidents (Anderson & Yeates, 2010). In South Africa, the primary cause of pTBI is a pedestrian MVA (Schrieff et al., 2013).

Sequelae. Children who sustain mild TBIs typically have few long-term consequences. However, children with severe TBI are particularly at risk for death or disability (Babikian & Asarnow, 2009; Padayachy et al., 2012). Hence, a dose-response relationship exists in terms of TBI and outcome – the more severe the injury, the more severe the outcome.

A considerable body of literature exists regarding the physical, cognitive, emotional, and behavioural effects of pTBI. Impairments in general intellectual functioning, executive functioning, attention, memory, learning and language, as well as behavioural changes, psychiatric disorders, academic challenges and familial disruption, are common effects of pTBI (Anderson et al., 2001b, 2009; Anderson & Yeates, 2010; Babikian & Asarnow, 2009; Bishop, 2008; Catroppa, Anderson, Godfrey, & Rosenfeld, 2011; Catroppa, Anderson, Morse, Haritou, & Rosenfeld, 2007; Fay et al., 2009; Ganesalingam et al., 2007; Hawley, 2004; Holm, Schönberger, Poulsen, & Caetano, 2009; Park, Allen, Barney, Ringdahl, & Mayfield, 2009; Taylor et al., 2008; Tonks, Williams, Frampton, Yates, & Slater, 2007).

The literature frequently reports deficits in basic attentional abilities (e.g. sustained and selective attention) as well as in higher-order components of attention (e.g. attentional control, inhibitory control, shifting attention and divided attention; Anderson et al., 2001b, 2012; Catroppa et al., 2011; Konrad, Gauggel, Manz & Schöll, 2000). Young children who have sustained severe TBIs are particularly at risk of acquiring significant and persisting

attentional deficits. The frontal and temporal regions, which are most commonly affected in a TBI, support attentional networks, which continue to develop into adolescence. Therefore, lesions (localised or DAI) in these vulnerable areas can cause functional disruptions in attentional skill acquisition and development (Galbiati et al., 2009; Wilkinson et al., 2014).

What differentiates sequelae arising from a TBI sustained in childhood from a TBI sustained in adulthood is that children need to be considered in their developmental context. Children are likely to experience deficits across the lifespan resulting from the impact of the injury interfering with the acquisition of skills necessary for various developmental milestones. This disruption in skill acquisition is of great concern because skills acquired at a later developmental stage are often dependent on the successful acquisition of earlier developmental milestones. For example, for an individual to achieve the skill of attentional control, they must be able to selectively attend, self-regulate, self-monitor, and inhibit responses. If the child sustains a TBI which impairs their ability to selectively attend, as they develop into adolescence, they may have difficulty with attentional control (Anderson et al., 2005; Anderson & Yeates, 2010; Catroppa et al., 2007; Giza, Kolb, Harris, Asarnow, & Prins, 2009; Giza, Mink, & Madikians, 2007).

Factors affecting outcome. Although general patterns in pTBI sequelae have been well documented, predicting individual outcome is more complicated. The individual variability in outcome post-injury is influenced by a number of factors acting independently or in unison (Taylor, 2004). For example, injury related factors such as the age at which the injury was sustained, time since injury, nature of injury, severity of injury, management of secondary injuries, and resulting disabilities will impact on a child's recovery and post-injury functioning across one or more domains (Catroppa & Anderson, 2007; Catroppa et al., 2011; Giza et al., 2007; Greve & Zink, 2009; Javouhey et al., 2011; Slomine et al., 2002; Yeates et al., 2002). Similarly, constitutional factors such as premorbid functioning and developmental stage, as well as environmental factors such as family functioning, socio-economic status (SES) and psychosocial adversity and access to rehabilitation will determine how and to what extent child is affected post-TBI (Anderson et al., 2001a; 2011; Anderson, Morse, Catroppa, Haritou, & Rosenfeld, 2004; Anderson & Catroppa, 2006; Brenner et al., 2007; Prigatano & Gray, 2007; Taylor et al., 2004). In LAMICs such as South Africa, there are more risk factors and less treatment and rehabilitation facilities for pTBI, compared to HICs, likely leading to a poorer outcome (Alexander et al., 2009; Clarke, Aldous & Thomson, 2014; Javouhey et al., 2006; Levin, 2006).

Nevertheless, Anderson and Catroppa (2006) summarize recent findings: the children who have poorer outcomes tend to be those with the more severe injuries, premorbid developmental or behavioural problems, social disadvantage, and familial dysfunction. In comparison, children with milder injuries, who are older, and/or have more psychosocial support tend to show a better prognosis.

The long-term outcome for children who have sustained a TBI must be considered in the context of continual development. It is the child's environment, in conjunction with the brain's capacity for structural and functional reorganisation that provides the opportunity for maximum recovery. The purpose of rehabilitation post-pTBI is to provide a stimulating environment for the child in order to take full advantage of the neuronal reorganization potential.

Cognitive Rehabilitation

Cognitive rehabilitation "refers to a set of interventions that aim to improve a person's ability to perform cognitive tasks by retraining previously learned skills and teaching compensatory strategies" (Tsaousides & Gordon, 2009, p.173). However, Sohlberg and Mateer (2001) recommend the use of the term 'rehabilitation of individuals with cognitive impairment' as a more appropriate term for children, because it encompasses the lifelong nature of TBI sequelae and hence, intervention. Rehabilitation interventions can be implemented during acute, sub-acute, and post-acute phases of recovery, and can be administered by health professionals or family members (Tsaousides & Gordon, 2009). However, rehabilitation is unlikely to be implemented by family members without the supportive input of health professionals (Ylvisaker et al., 2005). Beaulieu (2002) argues that rehabilitation is vital for a child's recovery, and that it should start as early as possible for maximum effect. However, the optimal timing for introducing cognitive rehabilitation still requires research, as it is dependent on many factors including the child's age and developmental phase at the time of injury (van't Hooft, 2010).

The theoretical framework for cognitive rehabilitation rests in the plasticity vs. early vulnerability debate, and is also based on the mechanisms of neural recovery.

Theoretical framework of cognitive rehabilitation. There has been a longstanding debate in the literature as to whether the developing brain is more prone or more resistant to injury compared to the adult brain. Vulnerability theorists propose that the immature brain is more susceptible to injury, and plasticity theorists argue that that the immature brain has a greater capacity to reorganise itself after an injury has occurred. There are also two proposed theories of recovery following TBIs that are important to understand when designing and

implementing cognitive rehabilitation interventions. These two theories are restitution and substitution mechanisms of recovery (Rothi & Horner, 1983; Popernack, Gray & Reuter-Rice, 2014). These theories apply not only to TBIs, but also to other acquired brain injuries (ABIs), such as anoxia, tumours, infections and vascular diseases (Teasell et al., 2007). The plasticity vs. early vulnerability debate, as well as the restitution and substitution mechanisms, are discussed below.

Vulnerability and neural plasticity. Vulnerability theorists argue that predetermined processes are significantly disrupted when an injury occurs, indicating the fragility and susceptibility of the brain to injury. A poor outcome is therefore predicted (Anderson et al., 2011). Young children have not acquired the same skills and knowledge as adults have, and disruptions to rapidly developing neural networks cause significant cerebral damage. A "double-hazard" effect supports the vulnerability theory, as children who are both younger and have more severe injuries are considered to have the poorest outcomes (Anderson et al., 2005, 2010; Giza & Prins, 2006).

Plasticity refers to the intrinsic ability of the central nervous system to "respond in a dynamic manner to the environment and experience via modification of neural circuitry" (Anderson et al., 2011, p. 2198). In healthy development, plasticity allows one to adapt and form new neural connections in order to respond to the environment, such as when learning a routine. When a developing brain is injured, plasticity may allow neural circuits to reorganise, thus taking advantage of the lack of functional specificity. This flexibility reflects the capacity of the brain to battle against the odds for a positive recovery and outcome (Anderson et al., 2001b, 2011; Kim et al., 2009).

Anderson et al. (2011) argue that these two theories of plasticity and vulnerability fall on a continuum, with children's outcomes lying closer to one end or the other. Their placement on the continuum is influenced by factors such as the severity and nature of the injury, the age at which the child was injured, as well as environmental factors such as familial relationships and environment, specific interventions used and SES. The substitution and restitution mechanisms for developmental brain recovery are based on the concept of neural plasticity.

Restitution and substitution. Restitution refers to the brain's capacity to heal itself spontaneously post-injury. The underlying assumption is that "as the lesion area heals, the neural pathways resume activity and the functions subserved by the involved neural systems are restored" (Rothi & Horner, 1983, p. 74). One restorative-type process is diaschisis, which is a temporary cessation of functions of structures that are neuronally connected to injury

sites, but are not themselves damaged. After a severe injury, researchers theorize that the physiological functions (such as degree of blood flow or intracranial pressure) are acutely disrupted, and so the brain goes into a temporary state of shock, or inertia. Synaptic and cerebral activity is temporarily inhibited. However, as this temporary inhibition of function subsides, behavioural functions tend to improve. Following diaschisis, other processes can occur to assist in neuronal recovery such as regeneration (where damaged neurons, axons, and terminals regrow and restore themselves), collateral sprouting (axons may sprout new branches to re-establish functional networks) and denervation sensitivity (some post-synaptic cells become more sensitive to neurotransmitter reception; Anderson et al., 2001b; 2010; Rothi & Horner, 1983).

Substitution refers to a function transfer that takes place from damaged brain parenchyma to healthy brain parenchyma (Anderson et al., 2001b). There are two schools of thought with regards to substitution. Some argue that anatomical reorganisation takes place because some regions may lack specificity of function early in development, and may therefore subsume function that was previously stored in the damaged tissue (Anderson et al., 2001b). For example, some functions may transfer to the same neuroanatomical site in the opposite hemisphere (interhemispheric reorganisation), or to uninjured locations in the same hemisphere (intrahemispheric reorganisation). If there is limited healthy tissue available for transfer, the functions may be maintained in the damaged tissue as far as possible (intrahemispheric maintenance; Anderson et al., 2011). Others argue that substitution occurs due to behavioural compensation, where new routes for cognitive function develop at the exclusion of the injured tissue (Rothi & Horner, 1983).

These two theories of recovery provide the rationale for developing rehabilitative interventions. In other words, these interventions can take advantage of the brain's ability to heal itself (Popernack et al., 2014; Rothi & Horner, 1983).

pTBI cognitive rehabilitation. Consistent with restitution and substitution theories, researchers and clinicians agree that there are three general principles necessary for cognitive rehabilitation for children. These principles are restoration of function (a specific cognitive deficit is restored), functional adaptation (compensatory strategies are employed, such as using a diary to assist with a memory impairment), and environmental modification (adapting the environment to accommodate the individual; Anderson et al., 2001b).

It is crucial that an understanding of developmental profiles and mechanisms of recovery is present when designing, implementing and assessing cognitive rehabilitation for children (Prins, Giza, & Hovda, 2010). Pediatric rehabilitation after a TBI requires an

enriched and stimulating environment for the child that accounts for their needs and is based on the requirements of daily living. The goal is to ensure that the child can function as optimally as possible (Beaulieu, 2002; Ho, Epps, Parry, Poole, & Lah, 2011). Children require cognitive development in all areas to ensure success of their future education and independence (Limond & Leeke, 2005; Ylvisaker et al., 2005). However, attention and memory are among the most crucial functions in children, as these domains enable all learning and social adjustment (van't Hooft et al., 2003).

A recent meta-analysis has indicated that when rehabilitating attention, a more process-specific approach has more transferability outside of the rehabilitation setting, compared to a compensatory approach (Rohling, Faust, Beverly, & Demakis, 2009). However, many of the specifics of optimal pediatric rehabilitation are still unknown due to a lack of research in the field as well as methodological issues experienced by current researchers.

Methodological Issues in Research

Evidence for the efficacy of rehabilitation programs is limited due to the lack of well-designed research (Ross, Dorris, & McMillan, 2011). More specifically, there is a lack of experimental, prospective studies that have random assignment and control groups. It is therefore difficult to rule out extraneous variables and be certain that the interventions tested were successful (Anderson & Yeates, 2010; Wilson, Gracey, Evans, & Bateman, 2013).

There are also few research centres that have facilities to investigate long-term outcomes of rehabilitation; most of these focus on acute care. These research centres also struggle to recruit large numbers of children for studies, and inclusion criteria such as the severity or nature of injury are generally not well defined. In addition, effect sizes also tend to be small. Therefore, it becomes difficult to generalize findings. (Anderson & Yeates, 2010; Laatsch et al., 2007; Limond & Leeke, 2005; Ross et al., 2011; Ylvisaker et al., 2005).

Many of the children who are recruited are also likely to have pre-existing behavioural and learning difficulties as well as social disadvantage, which confound their prognosis and recovery (Anderson & Yeates, 2010). There is a long-standing theory that children who sustain TBIs generally have risk factors that predispose them to injury (Rutter, Chadwick, & Shaffer, 1983). For example, researchers have suggested that children with TBI may have higher levels of premorbid externalizing problems, somatic complaints, thought problems, and aggression compared to the general population (Olsson, Le Brocque, Kenardy, Anderson & Spence, 2008). In line with this thinking, many researchers have found that pre-injury abilities affect TBI outcomes in various domains such as cognitive, familial, academic,

adaptive, and behavioural outcomes (Anderson & Catroppa, 2005; Anderson, et al., 2001a, 2004, 2006b; Farmer et al., 2002; Fenwick & Anderson, 1999; Jonsson, Catroppa, Godfrey, Smedler & Anderson, 2013). Researchers therefore also struggle to select appropriate matched control groups for pTBI intervention studies.

Another difficulty researchers experience is selecting appropriate outcome measures. Neuropsychological assessments that are designed specifically for children, which are used in research to test the efficacy of rehabilitation programs, are scarce. The tests that exist are often psychometrically weak and are not always ecologically valid in terms of real-world functioning. In South Africa in particular, these tests often do not account for contextual factors such as the culture, language and SES of participants (Levin, 2004). Nevertheless, the majority of cognitive rehabilitation studies use neuropsychological tests to assess intervention efficacy (as can be seen in Table 1). However, Wilson et al. (2013) argues that the purpose of rehabilitation is not to increase scores on psychometric tests, but rather to enable people with disabilities to live their lives as independently as possible post-injury. “Real life” measures can, however, be difficult to decide upon and track because they are of a qualitative nature.

There is also a lack of funding for research, which could be due to the inconclusive evidence to support the efficacy of post-acute stage rehabilitation (Anderson & Yeates, 2010; Levin, 2005). Another reason for the lack of funding could be related to the misconception that children’s brain are plastic and that they ought to recover well without intervention. However, as mentioned earlier, children’s post-injury deficits may be silent, and may only be revealed when more cognitive demands are placed on them, as they grow older (Anderson & Yeates, 2010). This discrepancy in opinion of pediatric brain injury and recovery is known as the plasticity vs. vulnerability debate, and forms the theoretical framework of cognitive rehabilitation.

Although Laatsch et al. (2007) and Cicerone et al. (2011) agree that a multitude of methodological difficulties exist in the field, their more recent reviews are more optimistic that promising and effective techniques have been and are in the process of being developed and tested. Moreover, many of the limitations discussed are evident because cognitive rehabilitation for TBI is a young but growing field. Research in pediatric cognitive rehabilitation is even more scant compared to the knowledge accumulated on adults (Gordon et al., 2006). However, even if the research in the field becomes more sophisticated, the issue of access to, and availability of, cognitive rehabilitation is still pertinent.

Access to, and availability of, cognitive rehabilitation

Although cognitive rehabilitation could be a valuable tool, many children are unable to engage in such programs post-TBI due to their family's financial situation and/or the country's lack of rehabilitation centres and programs. There may also be distrust from the family towards medical professionals due to misconceptions of rehabilitation. For example, some health professionals tend to make overly optimistic or overly pessimistic statements towards family members, giving them either unrealistic or dismal expectations of the child's prognosis after rehabilitation. Families may also feel hesitant to begin rehabilitation because of lack of evidence for the efficacy of interventions, or due to the trauma that they have experienced, thus making them unwilling to participate in rehabilitation (Beaulieu, 2002).

After the acute recovery phase, many children have overcome some or all of their physical disabilities and return to their pre-injury life. Their persistent cognitive or emotional difficulties may be invisible to family, friends, teachers and professionals, however. Children may thus be scorned unnecessarily for doing poorly academically or being disruptive, which may exacerbate their negative outcomes (Laatsch et al., 2007; Limond & Leeke, 2005; Yeates et al., 2004; Ylvisaker et al., 2005).

It is therefore vital to conduct quality research on rehabilitation programs. If there is strong evidence for their success, they can be made more accessible and they can be developed further.

Access to, and availability of, cognitive rehabilitation in South Africa. As is the case in most LAMICs, previous literature suggests that the needs of children who have sustained TBI in South Africa are not met (Levin, 2004, 2006). International models of healthcare assume that children have access to high quality acute-care and sub-acute care in a regular pediatric ward, followed by supported home-based care, and lastly access to rehabilitation (Blosser & De Pompei, 2003). However, in South Africa there are certain hospitals which offer an excellent quality of service, but there are few local neuropsychological rehabilitation centres available for children with TBI for their acute or long-term needs. Children are usually accommodated for in adult rehabilitation centres which do not cater specifically for pediatric injuries (Levin, 2004). Medical aid schemes create a further barrier to rehabilitation services, as they typically do not cover some or all of the necessary costs (Doherty & McLeod, 2002). Thus, children who are able to return to school post-injury still have cognitive difficulties that are not being treated. These children are usually unable to cope with the demands of their environment, and teachers are not always equipped to assist them appropriately (Levin, 2004). Other children, particularly in rural

areas, tend to stay at home after their injury, as rehabilitation is both inaccessible and unaffordable (Doherty & McLeod, 2002).

Despite issues surrounding the availability of, and access to cognitive rehabilitation, particularly in LAMICs such as South Africa, there is growing support and evidence for cognitive rehabilitation for children. Attention training for both adults and children is one approach that has commonly been reported as efficacious. Evidence suggests that attention moderates sensory, cognitive and emotional systems (Posner & Rothbart, 2007). It is therefore likely that difficulties in attention could underlie many pervasive difficulties post-TBI (Anderson et al., 2001b; 2005; van't Hooft, 2005; van' Hooft et al., 2003; Yeates et al., 2005).

Attention

Definition. Attention is a multidimensional construct that refers to the mechanisms through which individuals have an awareness of the world and have conscious thoughts and emotions in relation to it (Posner & Rothbart, 2007; Sinclair & Taylor, 2008).

Models of attention. Attention has been studied via cognitive models such as Treisman's Attenuation Theory (1960), Feature Integration Theory, and late-selection models (Deutsch & Deutsch, 1963; Norman, 1968; Treisman, Kahneman, & Burkell, 1983; Treisman & Gelade, 1980). Other researchers such as Mesulam (1981), Posner (Posner & Fan, 2008; Posner & Rothbart, 2007), and Corbetta and Shulman (2002) conceptualize attention on a neuroanatomical basis. Sohlberg and Mateer (1987) put forward a clinical model of attention that was based on attention–focused research and their personal clinical experience of working with patients who have sustained brain injuries.

Given its multidimensional nature and representation within various areas of the brain (as demonstrated by these models), it is not surprising that attention is considered to be the foundation for cognition. Attention interacts with other cognitive domains, and must be preserved in order for those other domains (e.g. memory processes) to function optimally (Anderson et al., 2001b; Lyon, 1996). For example, in Anderson's (2002) model of executive functioning, attentional control subserves all higher order functions such as cognitive flexibility, goal setting, and information processing.

Although these many theoretical models of attention exist, this study will primarily use a clinical theoretical basis, because the intervention employed in this study is based on Sohlberg and Mateer's clinical model of attention (1987).

Sohlberg and Mateer's clinical model of attention. According to Sohlberg and Mateer (1987), attention is a hierarchical process. Tasks that require higher-order levels of attentional capacity require lower levels of attentional capacity to be intact. Higher-order attentional capacities are also theorised to depend on executive abilities.

Sohlberg and Mateer (1987) distinguish five domains of attention in their model. These domains, in order from least to most resource-intensive, are: focused attention, sustained attention, selective attention, alternating attention, and divided attention. Each of these domains is now further examined.

Focused attention. Focused attention, the most basic level of attention, is the ability to respond to specific sensory information in a visual, audio or tactile modality. This type of attention is disrupted in individuals with lowered levels of consciousness, such as when emerging from a coma (Sohlberg & Mateer, 1987). The rehabilitation program under investigation is not designed to remediate focused attention, and will therefore not be discussed further.

Sustained attention. This is the ability to focus attention on a specific task over a period of time. Therefore, performance on a task will decrease or fluctuate over time should sustained attention be impaired (Anderson, Anderson, & Anderson, 2006a). Sustained attention often requires the involvement of working memory and mental tracking capacities, in order to manipulate information and problem solve (Sohlberg & Mateer, 1987). If the ability to sustain attention is compromised in pTBI, a child will not be able to concentrate for long periods of time on a task, or may miss important pieces of information, making school assignments and social development more challenging (Ginstfeldt & Emanuelson, 2010).

Selective attention. This is the ability to attend to and to extract relevant information while simultaneously ignoring distracting stimuli (Ginstfeldt & Emanuelson, 2010). Should selective attention become impaired in pTBI, a child will struggle to locate a target amidst distractors (Sohlberg & Mateer, 1987). For example, a child may be unable to listen to a teacher's instructions if there are other background noises such as children playing and talking or laughing outside.

Alternating attention. This refers to the ability to switch attentional focus from one task to another (Sohlberg & Mateer, 1987). This skill allows children to cease one task and begin another, or to switch rapidly between tasks (Thomson et al., 2005). Should this function be impaired children may, for example, have difficulties looking at a picture and subsequently answering questions about it on a worksheet.

Divided attention. This is the ability to attend to multiple stimuli simultaneously (Anderson et al., 2006a). In a school environment, children are required to learn large amounts of information in a stressful environment. In the case of pTBI, children may have significant and persistent academic difficulties if they are unable to focus their attention on multiple tasks simultaneously. This means that tasks may not be completed, or if they are they may not be of optimal quality (Ginstfeldt & Emanuelson, 2010). For example, students may be unable to listen to a teacher's instructions and write them down simultaneously (Sohlberg & Mateer, 1987).

Development of attention. The various components of attention tend to follow a general pattern of development. Attentional markers of dysfunction such as inattention, impulsivity, and response inhibition may be observable in children aged 5-7 (Bartgis, Thomas, Lefler, & Hartung, 2008; Kanaka et al., 2008; Klenberg et al., 2001; Wassenberg et al., 2008). At the age of 7 or 8, there is a rapid development of attentional components such as focused, shifting, sustained, and selective attention (e.g., Betts, McKay, Maruff, & Anderson, 2006; Greenberg & Waldman, 1993; Klenberg, Korkman, & Lahti-Nuuttila, 2001; Klimkeit, Mattingley, Sheppard, Farrow & Bradshaw, 2004; Rebok et al., 1997; Wassenberg et al., 2008). Around the age of 9, children should learn self-regulation and self-monitoring strategies (Anderson, Damasio, Tranel & Damasio, 2000; Klenberg et al., 2001; Wassenberg et al., 2008). Higher-order attentional processes, such as attentional control, as well as improved control of the basic attentional processes, are considered to develop later in adolescence and then plateau (Zhan et al., 2011). Because attention develops in a multi-stage manner, it is important to consider the developmental trajectories of not only attention in general, but the subcomponents thereof, particularly in the context of a TBI where development of a component could be disrupted.

Attention and pTBI. The results of various studies show that different brain regions are responsible for processing different components of attention (i.e. sustained, selective, divided and alternating attention; Booth et al., 2003; Lévesque, Beauregard, & Mensour, 2006; Sarter, Givens, & Bruno, 2001; Sylvester et al; 2003; Vohn et al., 2007). These regions are linked, and as they mature during normal development, the child's attentional capacities progress (van't Hooft, 2005). Contemporary models argue that attention is an integrated functional system; hence, if one component is damaged, the entire system may be affected, albeit in different ways. The prefrontal cortex and subcortical structures are vital for the optimal functioning of this attentional system, and these areas are most vulnerable to the impact of TBI (Anderson et al., 2012). A focal lesion in a brain region responsible for

attention that is still developing can cause structural and functional changes (Anderson et al., 2000). It is therefore understandable why one of the most common and difficult outcomes after pTBI is an attentional deficit both in the acute and chronic phases of recovery (Allen et al., 2010). There is also a dose-response relationship in terms of the severity of the injury and the attention deficits that will be experienced: the more severe the injury, the worse the child's attentional deficits (Anderson et al., 2012; Catroppa et al., 2007; Kurowski et al., 2011).

If a child cannot pay attention, they will find it difficult to learn from the environment and to acquire new skills, which can lead to long-term behavioural problems (Anderson et al., 2006a; Ginstfeldt & Emanuelson, 2010; Park et al., 2009; Yeates et al., 2005). Almost 50% of children who sustain TBIs will have attention problems that are new, worsening, or persistent (Backeljauw & Kurowski, 2014). Gerring et al (1998) reported that the prevalence of premorbid primary ADHD (P-ADHD) in children with TBI is 20%, whereas the prevalence of P-ADHD in the general population is 4.5%. More recent studies have shown that 16%-20% of children with TBI and without premorbid attentional problems are likely to develop S-ADHD (Bloom et al., 2001; Max et al., 2005; Sinopoli, Schachar, & Dennis, 2011; Slomine et al., 2005; Yeates et al., 2005). Children diagnosed with S-ADHD also tend to have attention-related difficulties evident in memory and executive function domains (Slomine et al., 2005). Additionally, premorbid attention difficulties are intensified post-TBI (Slomine et al., 2005; Yeates et al., 2005). Because attentional deficits post-TBI can have such devastating effects on a child's development, it is important to investigate different attention training interventions in order to avoid or reduce persistent and progressive difficulties (Backeljauw & Kurowski, 2014).

Attention training for pTBI. Since the 1980s, there has been a growing interest in attention training as a form of cognitive rehabilitation (Galbiati et al., 2009). In a meta-analysis of cognitive rehabilitation, Rohling et al. (2009) concluded that there is "sufficient evidence for the effectiveness of attention training after traumatic brain injury" (p.20). Research efforts to improve attention falls into four different categories: Attention Process Training (APT), self-management strategies and environmental modifications, external aids, and psychosocial support (Galbiati et al., 2009; Michel & Mateer, 2006; Mulligan, 2001; Sohlberg & Mateer, 2001). While the majority of attention training interventions are adult focused (see Backeljauw & Kurowski, 2014), there are few studies that have concentrated on cognitive rehabilitation strategies for children (Galbiati et al, 2009).

I will now briefly review some of the attention training interventions that have been

used in pTBI research in chronological order, and motivate why I chose to investigate the efficacy and feasibility of the 'Pay Attention!' intervention. Table 1 summarizes all of these pTBI attention-training studies to date, including samples of children with ABI, where pTBI was included. As can be seen from the table, the studies have a wide range of sample sizes and include children with mixed or unspecified etiologies and severity of their brain injuries. Study outcomes also vary.

Thomas-Stonell, Johnson, Schuller, and Jutai (1994) were one of the first groups of researchers to investigate the efficacy of attention training for children with TBI using the TEACHware software. TEACHware is a computerised program designed to train 5 cognitive domains: attention, memory and word retrieval, comprehension of abstract language, organisation and reasoning/problem solving. These modules are facilitated by a trainer and are presented in a game format with 3 levels of difficulty. This program, however, has not shown efficacious results on a pTBI sample (Thomas-Stonell et al., 1994).

The APT program is a widely used attention training intervention designed to rehabilitate attention in individuals who have sustained brain injuries (Mateer, Kerns, & Eso, 1996; Palmese & Raskin, 2000; Park, Proulx, & Towers, 1999; Sohlberg, Johnson, Paule, Raskin, & Mateer, 1994; Sohlberg & Mateer, 1987, 2001; Sohlberg, McLaughlin, Pavese, Heidrich, & Posner, 2000; Thomson, 1995). The program consists of hierarchically organised tasks designed to improve different components of attention (i.e. sustained, selective, alternating and divided attention). Basic attentional skills are constantly stimulated as exercises are repeated, and the difficulty level of tasks increases as more complex levels of attention are trained. The APT is considered to have ecological valid outcomes, and the cognitive improvements are considered to improve a patient's quality of life outside of the rehabilitation process (Mateer et al., 1996; Palmese & Raskin, 2000). The APT has been used successfully in pTBI attention rehabilitation (Thomson, 1995). However, most of the published studies on APT were conducted over 10 years ago, as the program has been updated and adapted since then. 'Pay Attention!', the intervention under investigation, is one of these programs based on APT and will be discussed later.

There have been a number of studies conducted on attention training for children with ABI, where a pTBI sample has been included. Van't Hooft et al. (2003, 2005, 2007), Sjö, Spellerberg, Weidner and Kihlgren (2010), and Catroppa, Stone, Rosema, Soo and Anderson (2014) have examined the efficacy of the Amsterdam Memory and Attention Training for Children (AMAT-c), which is a training program that consists of three phases: sustained attention, selective attention, and mental tracking and memory. Each phase increases in

complexity. Children improve their memory and attention through practicing games and exercises on a daily basis, and through learning new specific attention and memory techniques (Hendriks & van den Broek, 1996). I was unable to gain access to this program at the time my study began as it was being translated into English.

RehaCom is a modular computer-assisted rehabilitation program designed to train six domains of cognitive function in individuals with impaired cognitive performance: attention, concentration, and vigilance; memory and learning; visuo-motor co-ordination; reaction time and precision; visuoconstructive ability; and solving problems and developing strategies. Sessions are facilitated by a trained therapist, and adapted to the individual's performance levels. The software monitors the client's time and accuracy in each game, and each game gradually increases in difficulty (RehaCom, 2014). According to the South African distributors of RehaCom, the program is currently still in use, but is no longer marketed in South Africa. One reason given was that when there are technical difficulties or the equipment malfunctions or breaks down, it is difficult for it to be fixed (C. Coetzee, personal communication, June 11, 2014). It was therefore not possible to use RehaCom by itself, or in combination with other attention training programs, as Galbiati and colleagues (2009) did.

Another program based on APT that has recently been developed and piloted is the Attention Improvement Management (AIM) program (Sohlberg, Harn, MacPherson, & Wade, 2014). This computerised therapy incorporates goal setting, metacognitive strategies, and computer-based exercises that have been designed to improve attention and working memory. All tasks and strategies are tailored to the client's individual needs, and become progressively more demanding. Some practice tasks are designed to be completed at home, and other tasks are facilitated by a trained therapist. Sohlberg, Harn, MacPherson, and Wade's (2014) study was, however, published after I completed data collection for the 'Pay Attention!' intervention. In addition, the significant outcomes reported post-intervention were variable.

There is also currently a rising trend in online "brain games" such as Posit Science, Lumosity, Mindsparke, Jungle Memory and Cogmed, which claim to improve cognition in healthy and clinical populations. The majority of these kinds of programs are backed by both evidence and hype (Rabipour & Raz, 2012). For these reasons, their efficacy across the literature is inconclusive (Tompkins, 2013). The primary concern amongst researchers is around the ecological validity and transferability of improved cognitive function post-intervention (Hulme & Melby-Lervåg, 2012; Jaeggi, Buschkuehl, Jonides & Shah, 2012;

Redick et al., 2013; Shipstead, Hicks & Engle, 2012; Roche & Johnson, 2014). These brain-training programs also tend to focus on working memory, and other cognitive functions across domains. Many do not focus specifically on training attention, and their efficacy has not yet been assessed for improving attention in children post TBI. In LAMICs such as South Africa, many children do not have access to computers, and so these kinds of programs may not be appropriate, or even possible.

The research presented thus far supports an exploration of the efficacy of attention training cognitive rehabilitation programs for children who have sustained a pTBI, as there have only been limited studies of this nature published. Pay Attention!, the specific intervention program that was evaluated in the current study is now introduced.

Table 1

Previous Studies on Attention Training for Children who have Sustained ABIs

Study	Research Design	Sample	Intervention	Outcome measures	Outcome	Limitations
Thomas-Stonell et al. (1994) [a]	Prospective randomised control cohort study	12 participants with TBI[b], aged 12 – 21, 3 months – 4 years post-injury	TEACHware, 8 weeks	Paced Auditory Serial Addition Task	No significant differences found on attention post-assessments	Small sample size and wide range of years since injury
Thomson (1995)[a]	Single case study	6 teens with moderate-to-severe TBI[b], aged 14-17, within 1 year post-injury	APT[c], 12 weeks, implementation unspecified		Notable gains made in psychometric measures of attention	No control group, materials had not been adapted for children
Brett & Laatsch (1998)[a]	Repeated measures	10 teens with ABI[d], aged 14-18 (6 of whom had mild-to-moderate TBI[b]), 2-16 months post injury	CRT[e], 20 weeks, twice a week		Verbal learning and memory improved	No control group
Van't Hooft et al (2003)	Randomised control study	3 children with ABI[d], aged 9-16, (2 of whom had TBI[b]), 3 to 5 years post-injury	AMAT-c[f], half an hour a day for 20 weeks	Bourdon-Vos, Visual and Auditory Reaction Time Tests, Stroop-Colour and Word Test, the Binary Choice Test, Trail Making Test, 15-Word Test, Seashore Rhythm Test, RMBT[g], subtests from the WISC-III[h], Deasey-Spinetta Behaviour rating scales	Significant improvements noted in the majority of tests of sustained and selective attention as well as memory performance. Parents and teachers reported improved academic performance and self-image	Small sample size, heterogeneity of brain injury, injury severity and time since injury
Van't Hooft et al. (2005)	Randomised control study	38 children with ABI[d], aged 9 -16 (12 of whom had TBI[b]), 1-5 years post-injury	AMAT-c[f], 30 minutes daily for 17 weeks	Visual and Auditory Reaction Time Tests, GDS[i], Stroop-Colour and Word Test, the Binary Choice Test, Trail Making Test,15-Word Test, ROCF[j], RMBT[g], subtests from the WISC-III[h]	Significant differences were found in the intervention group for the majority of tests of sustained and selective attention as well as memory performance	Small sample size, heterogeneity of brain injury, control group did not receive any therapeutic support

Van't Hooft et al (2007)	Repeated measures	38 children with ABI[d], aged 9 -16 (12 of whom had TBI[b]), 1-5 years post-injury	AMAT-c[f], 30 minutes 6 days a week for 17 weeks	Visual and Auditory Reaction Time Tests, GDS[i], Stroop-Colour and Word Test, the Binary Choice Test, Trail Making Test, Digit Span Test, 15-Word Test, ROCF[j] , RMBT[g], WISC-III[h]	Treatment groups maintained improvements in complex attention and memory tasks 6 months post-intervention	Small sample size, heterogeneity of brain injury, control group did not receive any therapeutic support
Galbiata et al (2009)	Open-label nonrandomized controlled trial	65 children with severe TBI[b], aged 6 – 18, 6-10 months post-injury	15 minutes with a tabletop task[k] (Marzocchi, Molin & Poli, 2000) and 30 minutes of RehaCom or Attenzione e Concentrazione[k] (age appropriate computational tasks) 4 times a week for 6 months (Di Nuovo, 1992; Schuhfried, 1996)	CPT-II[l], WISC-R[m]/WAIS-R[n], VABS[o]	Improvement in both the experimental and control groups accounting for natural recovery. However, at 1 year follow up, intervention group had maintained improvement in attention skills and adaptive skills compared to controls	Lack of ecologically valid measures and parent/teacher reports, and VABS data for pre-injury function was unavailable
Sjö et al. (2010)	Repeated measures	7 children with ABI[d], aged 8-16 (3 of whom had TBI[b]), 0.8 to 8 years since injury	AMAT-c[f], 45 minutes a day 5 times a week for 18-20 weeks	WISC-III[h] subtests, Neuropsychological assessment of the school-aged child, TEA-Ch[p] subtests, BRIEF[q]	Children showed significant improvements in learning and memory subtests, but not in executive function	Small sample group, no control, no measure of functional outcome
Ho et al. (2011) [r]	Prospective cohort study	15 children with mild-to-severe ABI[d], aged 11-17, (9 of whom had TBI[b]), 1-12 years post-injury	Everyday memory rehabilitation program for 1 ½ hours once a week for 6 weeks	Parent Memory Questionnaire, Child Memory Questionnaire, school diaries, WISC-IV[s]/WASI[t], RAVLT[u], subtests from TEA-Ch[p] and WIAT-II[v], CBCL[w]	Improvements in everyday memory and significant incidental improvement in selective/focused attention and attentional control	Self-selected cohort that was not randomized, small sample size, limited and inconsistent cognitive testing

de Kloet, Berger, Verhoeven, van Stein Callenfels, & Vliet Vlieland, (2012)[r]	Prospective cohort study	50 participants with ABI[d], aged 6-29 (27 of whom had TBI[b]), 9-39 years post-injury	Nintendo Wii, 2 hours a week for 12 weeks	Measure of time spent on recreational activity, CARE[x], AMT[y], GAS[z], PedsQL[aa]	Significant improvements on both tests of attention, as well as in time spent engaged in physical activity, processing speed, response inhibition and visuomotor coordination	No control group, heterogeneity of brain injury
Schrieff (2013)	Pilot case-controlled study	16 healthy children, aged 7-10, (4 of whom had moderate-to-severe TBI[b]), 1-2 years post-injury	'Pay Attention!' twice a week for 45 minutes for 10 weeks[bb]	Subtests from the CMS[cc], TEA-Ch[p] and NEPSY[dd], ROCF[j], CBCL[w], BRIEF[q]	School grades and inhibition improved in one child with TBI	Small sample size, no TBI no-intervention control group, examiners were not blind as to group assignment.
Catroppa et al. (2014)	Case study	3 children with ABI[d], aged 8-13 (1 of whom had a TBI[b]), at least 1 year post-injury	AMAT-c[f]	Subtests from the CMS[cc] and TEA-Ch[p], WASI[t], BASC[ee], OMQ[ff], BRIEF[q], ABAS[gg], CBCL[w]	Children's attention and memory improved, with results maintaining 6 months post-intervention	Small sample size, heterogeneity of injury
Sohlberg et al (2014)	Repeated measures	11 children with complicated mild-to-severe TBI[b], aged 10-18, 5-99 months post injury	AIM[hh], 10 weeks. 8-12 in-clinic sessions and 15-41 20-40 minute at home sessions.	BRIEF[q], subtests from TEA-Ch[p] and DKEFS[ii], GAS[z]	Variable post-test results found in the neuropsychological post-tests, but positive improvements noted on the Inhibition and Shifting subscales of the BRIEF	Small, heterogenous sample with great variability in intervention attendance. Multiple intervention therapists. No control group

Note. [a]Information is missing as the full article was unavailable online. Information was taken from the abstract and/or Limond and Leeke (2005); [b] Traumatic brain injury; [c]Attention Process Training; [d] Acquired Brain Injury; [e]Cognitive Rehabilitation Therapy; [f]Amsterdam Memory and Attention Training for Children; [g] Rivermead Behavioural Memory Test. [h]Wechsler Intelligence Scale for Children – Third Edition; [i]Gordon Diagnostics System [j]Rey-Osterrieth Complex Figure; [k]Further information unavailable in English; [l]Conner's Continuous Performance Task – Second Edition; [m]Wechsler Intelligence Scale for Children – Revised; [n]Wechsler Adult Intelligence Scale – Revised; [o]Vinelands Adaptive Behaviour Scale; [p]Test of Everyday Attention for Children; [q]Behaviour Rating Inventory of Executive Function; [r]This study was not an attention training intervention, but has been mentioned as secondary gains in attention were found; [s]Wechsler Intelligence Scale for Children – Fourth Edition; [t]Wechsler Abbreviated Scale of Intelligence; [u]Rey Auditory Verbal Learning Test; [v]Wechsler Individual Achievement Test – Second Edition; [w]Child Behaviour Checklist; [x]Chilren's Assessment of Recreation and Enjoyment; [y]Amsterdam Neuropsychological Tasks; [z]Goal Attainment Scaling; [aa]Pediatric Quality of Life, [bb]Intervention to be discussed below; [cc]Children's Memory Scale; [dd]A Developmental NEuroPSYchological Assessment; [ee] Behaviour Assessment System for Children; [ff] Observer Memory Questionnaire – Parent Form; [gg]Adaptive Behaviour Assessment System; [hh]Attention Improvement Management; [ii]Delis-Kaplan Executive Function System.

‘Pay Attention!’

The cognitive rehabilitation program, ‘Pay Attention!’, is based on the theoretical model of attention by Sohlberg and Mateer (1987). The intervention was designed as an attention-training program for children aged 4 – 10, as an adaptation of the adult APT program (Sohlberg & Mateer, 1987). Efficacy has been demonstrated for APT with adolescents and adults who sustained mild, moderate and severe TBIs (Palmese & Raskin, 2000; Pero, Incoccia, Caracciolo, Zoccolotti, & Formisano, 2006; Thomson, 1995; Thomson & Kerns, 2000) and ABI (Sohlberg & Mateer, 1987; Sohlberg et al., 2000).

The authors of the intervention hypothesized that attention can be improved through structured and focused exercises. The idea is that when exercises that place attentional demands on the child are executed repeatedly, brain systems responsible for attention are repeatedly activated, and this will lead to an improvement in functioning (Thomson et al., 2005). Transfer of function is thus expected, meaning that improvement should not be confined to tasks and testing, but should extend to everyday life (Tamm et al., 2010). As previously discussed, the mechanism behind this improvement may be that of restitution and/or substitution (Sohlberg & Mateer, 2001).

Previous studies conducted on ‘Pay Attention!’. The program was first investigated with 14 children aged 7 – 11, who had a P-ADHD diagnosis (Kerns, Eso, & Thomson, 1999). The children were divided into two groups and matched on age, sex and medication status, where half were given the attention training program during 30 minute sessions twice a week for 8 weeks, and the other half were required to play computer games. Both groups were pre- and post-tested with measures of attention and academic efficiency. Parents and teachers were also asked to complete behaviour-rating scales about the children. Post-intervention, both groups showed an improvement. However, the treatment group showed significantly greater improvement on tests of selective attention as well as on maths worksheets, which were used as the measure of academic efficiency, compared to the contrast group. In addition, teachers, but not parents, reported more attentive and less impulsive behaviour in the treatment group. The researchers concluded that this intervention can improve selective, sustained and higher levels of attention, hence supporting their hypothesis that repetitive attention training tasks will improve attention in children diagnosed with P-ADHD (Kerns et al., 1999). The main critique of this study was that a control group was not included in order to exclude practice effects.

Based on the promising results of this study, Penkman (2004) implemented ‘Pay Attention!’ with a 6-year-old survivor of acute lymphoblastic leukemia for one hour weekly

for a period of 6 months. Improvements in tasks assessing reaction time, arithmetic and sustained attention were observed. Parent report data went from the markedly atypical range at pre-test, to the normal range at post-test (Penkman, 2004).

Chenault, Thomson, Abbott and Berninger (2006) administered 'Pay Attention!' to 10 children in grade 4, 5 or 6 who met the research criteria for dyslexia. The control group consisted of 10 dyslexic children in the same age range who engaged in a reading fluency training program. Both groups had ten 25-minute training sessions of their respective intervention. All 20 children then received group composition instruction training, aimed at improving literacy. Both groups were assessed at pre-, mid- (after 'Pay Attention!' or reading fluency training) and post-intervention (after composition training). Although students who received the 'Pay Attention!' training did not show immediate improvements in reading, writing, and attention/executive function on a battery of tests, they showed better progress in composition writing and oral verbal fluency compared to the children who received the reading fluency training, after the composition training had taken place. The sample size in this study was however, small.

In a more recent study, 23 children aged 7 – 15 who were diagnosed with P-ADHD, participated in two 30-minute sessions of 'Pay Attention!' per week for a period of 8 weeks, to examine the feasibility and efficacy of the program in a clinical setting (Tamm et al., 2010). Children were assessed on a neuropsychological battery of attention and executive function, and parents and teachers were asked to complete rating scales of the child's attention, executive functioning and behaviour. The researchers concluded that the program is feasible to administer, and parents and participants saw the program as beneficial. In terms of efficacy, psychometric testing revealed significant improvements in fluid reasoning and cognitive flexibility, working memory, and metacognitive skills. In addition, parents and teachers reported a decrease in ADHD symptoms. These results showed moderate to large effect sizes. These findings are consistent with the results in the first study (Kerns et al., 1999). At a 9-month follow-up, children's ADHD symptoms did not appear to worsen, and gains were still maintained. Study limitations include a small sample size, insufficient teacher data and a lack of a control group.

This same research group extended their research of 'Pay Attention!' (Tamm, Epstein, Peugh, Nakonezny, & Hughes, 2013), where their treatment group size increased from $n = 23$ to $n = 54$, and added a control group of $n = 51$. The sample included children who had been diagnosed with P-ADHD and ranged from 7 to 15 years of age. The researchers implemented the program for the same duration and intensity as their previous study. At the end of the

treatment, parents and clinicians reported significantly fewer ADHD symptoms and improved executive functioning skills. Children also reported that their attention had improved. Neuropsychological testing showed significant improvements on strategic planning efficiency, and an increase in group means in various domains of attention. However, teacher ratings did not indicate any significant improvement. Although the researchers improved on their study by including a control group, their study lacked teacher data.

In an unpublished pilot case-controlled study, Schrieff (2013) implemented the 'Pay Attention!' program with four children aged 7 – 10 who had sustained a severe TBI and who were raised in low SES backgrounds in South Africa. This study was the first reported to examine the feasibility and efficacy of the program in the specific context of South Africa, and with a sample of children with TBI. Three different healthy control groups (n= 4) from low SES backgrounds were used: a group who received the 'Pay Attention!' intervention, a group who did not receive the intervention but participated in regular play sessions with research assistants (RAs), and a group of children who received no intervention at all. In one child with TBI, improvements were evident in the Inhibition subtests of the NEPSY-II (A Developmental NEuroPSYchological Assessment – Second Edition), which is significant as inhibition is required for attentional processes to occur. This child's grades also improved post-intervention and her teacher reported an improved attitude towards her schoolwork. However, this study had a number of limitations. For example, there was a small sample size and no TBI no-intervention control group. Although strong results were not evident, the program showed potential for attention remediation and feasibility for the implementation of this intervention, which the current study aims to explore.

The Current Study

pTBI is a devastating event for the child who is directly affected, as well as for their families. Deficits in attention are likely to occur post-injury, which could negatively affect children's everyday learning, development and recovery. 'Pay Attention!' is a training program that specifically focuses on improving attention. Although there are limitations in previous research studies, there is evidence that this program could be effective. It is however acknowledged that the majority of these previous studies have been carried out with children with P-ADHD; hence most of the available evidence for the efficacy for the 'Pay Attention!' intervention is for this particular clinical sample and not for secondary ADHD as a result of TBI. Although the presentation of P-ADHD and S-ADHD may be similar, the underlying pathology and neuropsychological mechanisms are different (Kramer et al. 2008; Ornstein et al., 2014; Sinopoli et al., 2011)**.** However, given the limitations in previous research

generally, there remains a need to generate more research on this intervention, and explore the effects of this training in South Africa with a pTBI sample specifically, for whom neuropsychological rehabilitation is virtually non-existent in this context.

Aims and Hypotheses

There was 1 primary research question for this study which was also the major aim of this study, and 2 secondary, more exploratory aims. First, I aimed to investigate the efficacy of the 'Pay Attention!' intervention program for children with moderate-to-severe TBI in South Africa. My hypothesis was that the 'Pay Attention!' rehabilitation program would improve attention in South African children who had sustained a TBI.

In doing so, I had a second, more exploratory aim. I aimed to compare the performance on the program of children who sustained a pTBI, with the performance on the program of children diagnosed with ADHD, considering that Pay Attention! was initially developed for, and has been shown to be efficacious with, the latter group.

I also had a third aim that was also exploratory, which was to investigate the feasibility of implementing a cognitive rehabilitation intervention in a LAMIC setting.

Methods

Research Design and Setting

Pre-testing, post-testing and the intervention took place at the University of Cape Town (UCT), RXH and at one school in Cape Town, depending on both room and participant availability.

This study is a quasi-experimental pre-test post-test controlled trial. There were four independent groups in this study that each initially began with 5 children. The decision to use 5 children was based on availability of resources and time constraints given the intensive one-on-one nature of this study (e.g. 5 children x 45 minutes per week x twice a week x 12 weeks = 90 hours in total). All other studies using 'Pay Attention!' have had small samples, with the exception of one study with $n = 54$ (Tamm et al., 2013). Other studies have had sample sizes ranging from $n = 1$ to $n = 23$ per intervention group (Chenault et al., 2006; Kerns et al., 1999, Penkman, 2004; Schrieff, 2013; Tamm et al., 2010). The current study also serves as a pilot for a potentially larger study.

Participants who sustained a pTBI were divided into one of three groups: the TBI Intervention Group, the TBI Art Group or the TBI Control Group. Participants who had been diagnosed with ADHD formed the fourth group: ADHD Intervention Group.

TBI Intervention Group. Participants in this group were trained on the 'Pay Attention!' program. I aimed to recruit 5 first language English speakers, between the ages of 7 and 8 years old, who were from low SES backgrounds. Children needed to have sustained a moderate-to-severe TBI at least 1 year before, and performed at least 1 standard deviation (SD) below the norm on 20% of the neuropsychological tests administered during the pre-test phase. Individuals with pre-morbid perinatal, developmental, neurological, psychiatric or psychological difficulties were initially not considered eligible for the study.

TBI Art Group. These children (n = 5) participated in an art group based on art therapy principles. Only a qualified and registered art therapist can facilitate Art therapy in its true form. Unfortunately, the art therapists that I approached for assistance with this project were not within the study's allocated budget. I then approached a Clinical Psychologist registered with the Health Professions of South Africa (HPCSA) and who has received basic training in art therapy and facilitates art therapy sessions in her private practice on a daily basis. The activities that she facilitated in the TBI Art Group were therefore based on art therapy principles, but cannot formally be termed art therapy.

Children in this group had the same inclusion and exclusion criteria as the children in the TBI Intervention Group, and I aimed to match them to the TBI Intervention Group based on age, gender, and injury mechanism and severity.

Purpose of the TBI Art Group. The purpose of the TBI Art Group was to control for the effect of time spent with the participants in the Intervention Groups. Given the children's low SES, it is likely that many of them do not have the opportunity to receive one-on-one attention from teachers, older siblings or parents. It is therefore possible that simply having an intervention that involves one-on-one attention, rather than the actual intervention program itself, could motivate children to perform better on the neuropsychological tests post the intervention period. Therefore, the extra stimulation for children from low SES homes may serve as a potential rival explanation for any changes seen pre- and post-intervention, and must therefore be controlled for (Stangor, 2011).

Rationale behind art therapy. Art therapy is "based on the idea that the creative process of art making facilitates reparation and recovery and is a form of nonverbal communication of thoughts and feelings" (Malchiodi, 2012, p. 1). A creative process is

evoked through stimulation from the art materials, and/or the materials are spontaneously used to express emotions (Lusebrink, 2004). Outcomes across art therapy studies are primarily emotion and behaviour-based. For example, in both children and adults, mood, self-efficacy, fatigue, self-esteem, and PTSD symptoms after trauma have been known to improve with art therapy (Chapman, Morabito, Ladakakos, Schreier & Knudson, 2014; Slayton, D'Archer, & Kaplan, 2010). Such positive outcomes were also reported in a recent South African study (Mueller, Alie, Jonas, Brown, & Sherr, 2011).

Art therapy was chosen as the control because although it has various therapeutic effects (Lusebrink, 2004), it is not as cognitively demanding an activity as 'Pay Attention!'. Although it requires children to sit still and engage in an activity, attention is not specifically being trained. In addition, it is an activity that can be executed in a one-on-one setting, like the attention training. It is therefore also important in assessing whether any structured focused activity twice a week could improve attention, or if it is the specific training effects of 'Pay Attention!' at work.

It can be argued that art therapy and attention training are similar activities or may accomplish similar goals. However, art therapy employs tactile and perceptual systems where emotions and meaning are processed both cognitively and verbally (Lusebrink, 2004). In contrast, 'Pay Attention!' trains attention in visual and auditory modalities (Thomson et al., 2005), and there is no evidence that the program activates emotional information processes. Although cognitive processes such as attention or memory may be activated during art therapy sessions (Lusebrink, 2004), these circuits are not specifically being trained as in cognitive rehabilitation.

Furthermore, in a comparative study of the mechanisms between a cognitive behavioural intervention and art therapy in patients with acute stress disorder, it was noted that in art therapy, materials are physically manipulated and physically created. In cognitive interventions, sensory stimuli are both imagined and processed mentally (Sarid & Huss, 2010). For example, art therapy activities are focused on expressing inner abstract thoughts in a concrete way, whereas in 'Pay Attention!', children have to mentally switch between tasks and manipulate information in working memory. These are different tasks, which should lead to different outcomes.

TBI Control Group. Participants in this group (n = 5) served as waitlisted-controls and had the same inclusion and exclusion criteria as the children in the TBI Intervention Group. I aimed to match them to the TBI Intervention Group based on age, gender, and injury

mechanism and severity. These participants received no intervention, but were pre- and post-tested on the neuropsychological battery.

Purpose of the TBI Control Group. The purpose of the test-only group was to control for practice effects, maturation effects and developmental trajectory. Attention in children may be developing or improving independently of the intervention, or may *appear* to improve in post-testing solely because the children have had practice on the pre-test tasks which are the same as the post-test tasks (Rohling et al., 2009; Stangor, 2011). It is also important to control for the effect of SES on test scores in the sample, as socio-economic factors have been shown to affect cognition (Hackman & Farah, 2009).

ADHD Intervention Group. Participants in this group were trained on the 'Pay Attention!' program. I set out to recruit 5 children from low SES backgrounds, aged 7 and 8 years, who spoke English as a first language, and who were diagnosed with ADHD according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association, 2013). I aimed to match the children in this group to the children in the TBI Intervention group based on age and sex. Initially, the exclusion criteria included that children should not present with comorbid perinatal, developmental, neurological, psychiatric and psychological difficulties.

Purpose of the ADHD Intervention Group. Children who have sustained a TBI and children who have been diagnosed with ADHD both have attention difficulties underpinning their functioning. Furthermore, there have been positive outcomes associated with the use of 'Pay Attention!' with children who have been diagnosed with ADHD. The intention was therefore to compare test results between a sample where significant results have been found, with the current sample where results remain inconclusive. In addition, the efficacy of 'Pay Attention!' in South African children diagnosed with ADHD has not yet been investigated.

Participants

Recruitment. I first approached health professionals for assistance with recruitment, which was unsuccessful. The sample was therefore primarily recruited through schools and the RXH. Two children were recruited via word of mouth.

Health professionals. I obtained ethical approval from the UCT Faculty of Health Sciences (FHS; see Appendix A), and then contacted 117 health professionals in private practice, private hospitals and government hospitals, to request assistance with recruitment. In order to recruit the pTBI sample, I e-mailed psychologists, psychiatrists, neurologists, neuropsychologists, neurosurgeons, pediatric surgeons, occupational therapists and

physiotherapists, and attached a participation information sheet for parents (see Appendix B). I requested that the letters be distributed to patients who may be eligible to participate.

In order to recruit the ADHD sample, I e-mailed psychologists, neuropsychologists, pediatricians and psychiatrists and attached a participation information sheet for parents (Appendix C). E-mails were followed up with more e-mails, and phone calls and/or meetings. One child with ADHD was referred from a private practice, however withdrew from the study before pre-testing as the mother felt the child would be too overwhelmed with an extra activity in his week. No other children were recruited this way. Most of the health professionals were willing to assist, however did not have patients who met the study criteria, and suggested we contact schools as well as the RXH.

Schools. I then obtained ethical approval from the Western Cape Education Department (WCED) to contact Learners with Special Educational Needs (LSEN) schools within a reasonable distance from UCT (Appendix D). Ten schools were subsequently e-mailed and/or called, and I requested that the participation information letters be distributed to parents. This initial contact was followed up with e-mails, phone calls and/or meetings. With the exception of one, the LSEN schools reported that their learners (those who had sustained pTBIs and those diagnosed with ADHD) have a myriad of comorbidities that would make them inappropriate for the study (e.g. fetal alcohol spectrum disorder (FASD), human immunodeficiency virus (HIV), cerebral palsy (CP), autism).

Nevertheless, one child who had sustained a TBI and three children diagnosed with ADHD were recruited through the schools, but only two of the children with ADHD met the pre-testing requirements for inclusion[4]. After receiving ethical approval from the WCED to contact ten mainstream schools, two more children diagnosed with ADHD were recruited in this way.

RXH. I then obtained ethical approval from RXH to access case folders and recruit via the hospital (Appendix E). I obtained information from ChildSafe, a South African non-profit organisation that captures statistics on accidental injuries and deaths at RXH, in the form of folder numbers of all the children who had sustained moderate-to-severe TBIs from January of 2008 to January of 2013 (n = 1107). I also obtained information about admissions of 137 children with severe TBI to the Division of Pediatric Neurosurgery. I narrowed down both sets of data to children aged 7 and 8 (n = 228), and accessed the case folders.

[4] The child performed in the average and above average range across most of the pre-tests.

The information for the majority of the folders (from the folder numbers from ChildSafe) were incorrectly captured and were in fact not TBIs (i.e. rather burns or neoplasms), were mild TBIs (i.e. no or brief LOC, GCS scores >13, children discharged the same day as the accident), or were HIs. Many folders had missing contact details, and others were excluded due to a history of multiple or open TBIs, HIV, shaken baby syndrome, CP, FASD, meningitis, epilepsy pre-TBI, brain tumors, ADHD pre-TBI, and residential location outside of Cape Town.

When I contacted parents from the remaining folders, many of the contact details were incorrect, parents had moved cities, parents did not speak English, children were deceased, parents reported no residual deficits from the TBI or parents were disinterested in the study. Nevertheless, twelve children were recruited through RXH, but after pre-testing only 10 children met the inclusion criteria[5].

I then began contacting 6-year-old children from the databases (see Appendix F for approval for amendment from UCT FHS), and was able to recruit three more children. The decision to extend the sample to younger children was made for two reasons. Firstly, I had exhausted the list of 7 and 8 year old children. Secondly, in the study upon which this research is based, Schrieff (2013) found positive results in the youngest child who was 7 years old, which suggests that the intervention may be more efficacious for younger children.

Word of mouth. One child with TBI was referred to the study by the Neuropsychology team at the Division of Child and Adolescent Psychiatry (DCAP) at RXH. One child with ADHD was recruited through a senior Neuropsychology intern at UCT.

The recruitment process was lengthy and spanned 6 months, mostly because the clinical samples under investigation are minorities: the majority of pTBIs are mild, and the majority of children with ADHD have comorbidies that complicate their diagnosis. In addition, factors in the South Africa context such as multilingualism (i.e. many participants having first and/or home languages other than English) and poverty (e.g. high risk for multiple medical illnesses) hindered the search for participants. Figure 1 summarizes from where the final participants were recruited.

[5] One child had sustained an open HI in addition their moderate TBI, which was not documented in the RXH medical folder. The mother of the second child had recently been informed that the child was HIV positive, and only disclosed this information at the end of pre-testing.

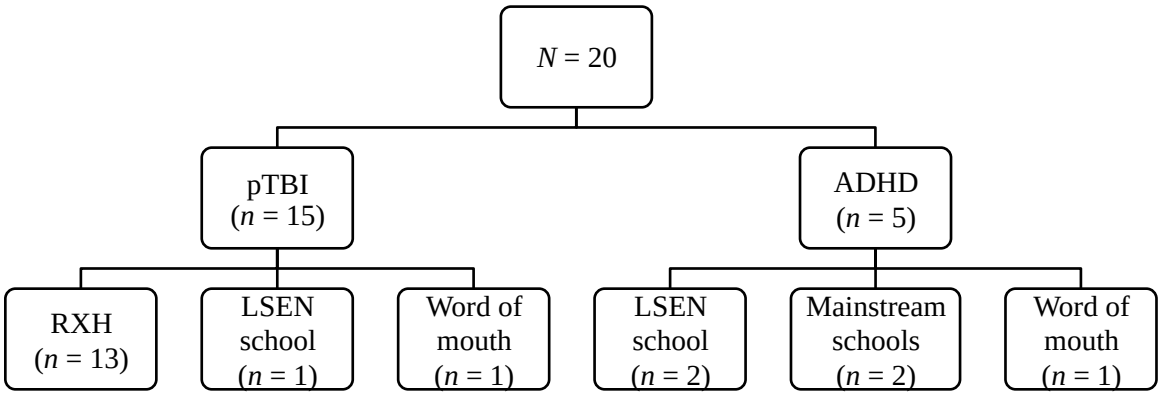

Figure 1. Summary of participant recruitment for pTBI and ADHD groups.

Inclusion criteria

SES. Because TBIs occur more frequently in LAMICs compared to HICs, children were recruited from South African lower and middle-income family brackets (Bartlett, 2002; Hofman et al., 2005; Hyder et al., 2007; Murgio et al., 1999).

However, when I contacted the lower SES schools to recruit the ADHD sample, many teachers informed me that although they suspect some children have significant attentional deficits, the children have not received a formal ADHD diagnosis. Although incidence rates of ADHD in poorer areas are likely to be higher than more urban and wealthy communities, ADHD is less commonly diagnosed in lower SES areas (Pillay, Naidoo, & Lockhat, 1999). For a diagnosis of ADHD to be made, the symptoms need to be present in two or more settings (e.g. home, school, other activities; American Psychiatric Association, 2013). ADHD symptoms are most noticeable in a structured school environment, however teachers in low SES schools in Cape Town (i.e. periphery of the Cape Town Metropole) have a poor overall knowledge of ADHD (Perold, Louw, & Kleynhans, 2010). Teachers in underprivileged areas are often under qualified and overwhelmed with large class sizes, and are less likely to detect ADHD symptoms compared to teachers in higher SES schools (Pillay et al., 1999). The ADHD sample was therefore recruited from a higher SES sector.

Language. Initially, an eligibility criterion was that children needed to be English-speaking, as the program is written in English and has not yet been translated. However, this was incredibly difficult criterion to meet. South Africa is a multi-cultural and multi-lingual country, where in the Western Cape, Afrikaans is spoken as a first language by 49.7% of the population, isiXhosa is spoken as a first language by 24.7% of the population and English as

a first language is spoken by 20.2% of the population[6] (Statistics South Africa, 2011). Bearing in mind that the moderate-to-severe sample pool for pTBI is small as is (Schrieff et al., 2013; Rickels, Wild, & Wenzlaff, 2010), it was not possible to find 15 first language English-speaking children that also meet the other criteria for the study.

After all pre-assessments were completed, the children who my supervisor and I (with input from the interns who conducted the neuropsychological testing) gaged to be the most proficient in English were placed into the intervention group, and the other children formed the control groups of the study. English proficiency was evaluated based on the child's language of instruction at school and exposure to English at home. The children diagnosed with ADHD were all first language English speakers, however.

Age. At pre-test, all children in the study were aged 6 to 8 years. Although the 'Pay Attention!' program was developed for children from ages 4 to 11, many of the tests used to evaluate the efficacy of the intervention are only normed for children from the age of 6 (e.g. Test of Everyday Attention for Children and the Connors' Continuous Performance Test-II). In addition, Schrieff (2013) suggested that 'Pay Attention!' materials are potentially more suitable for younger children with TBI in South Africa.

Attention deficits. Children were required to have a performance of at least 1 SD below the appropriate age norm on 20% of the attention pre-tests. This criterion is based on previous studies in attention training programs for children with TBI (van't Hooft et al., 2005; 2007).

pTBI criteria. Children who sustained a TBI must have had a moderate-to-severe closed TBI, as indicated by their GCS score (Teasdale & Jennett, 1974) at the time of injury. As discussed, the GCS score has been used in multiple studies to determine pTBI severity (Anderson et al., 2012; Ginstfeldt & Emanuelson, 2010; Catroppa et al., 2007; van't Hoof et al., 2003). In the case of the child referred from DCAP, the GCS at the time of injury was unknown as it took emergency medical services quite some time to arrive at the scene. However, the child's mother reported that he had been unconscious for at least half an hour, which is indicative of at least a moderate injury (Corrigan et al., 2010).

All pTBIs needed to have occurred at least 1 year prior to this study's initial assessment. Spontaneous recovery post-injury tends to occur in the first one-to-two years post injury (Anderson et al., 2001b; Ginstfeldt & Emanuelson, 2010; Yeates et al., 2002). This

[6] The other 5% of individuals speak isiNdebele (0.3%), isiZulu (0.4%), Sepedi (0.1%), Sesotho (1.1%), Setswana (0.4%), Sign Language (0.4%), SiSwati (0.1%), Tshivenda (0.1%), Xitsonga (0.2%), and Other (2.2%).

criterion is also consistent with other TBI studies in the field (Cope, 1995; Van't Hooft et al., 2005).

ADHD diagnostic criteria. Children in the ADHD Intervention Group must have been diagnosed with ADHD by a registered health professional according to the DSM-5 (American Psychiatric Association, 2013).

Exclusion criteria

Developmental difficulties. I excluded children with perinatal or development difficulties (e.g. CP or genetic abnormalities) with the exception of two children with TBI who were born prematurely (one of whom is a twin). However, all children in the study had normal developmental milestones as documented by their medical folder and/or reported by the parents/caregivers.

Prenatal exposure to substance use. Ideally, children who were exposed to drugs, alcohol or smoking in utero should have been excluded from the study. However, South Africa has one of the highest rates of FASD in the world, which is found predominantly in the Western Cape (where the current study was conducted). There are also large numbers of women who smoke and/or abuse alcohol or drugs while pregnant, particularly in the low SES areas in the Western Cape (Jones et al., 2011; May et al., 2014; Vythilingum, Roos, Faure, Geerts & Stein, 2012; Williams, Jordaan, Mathews, Lombard, & Parry, 2014). It was therefore not surprising that 8 out of 15 mothers in the pTBI sample smoked cigarettes, drank alcohol or took drugs while pregnant. However, in the medical folders, none of these children had received a diagnosis for any condition, or suspicion of any problems, related to the mother's substance use in pregnancy (e.g. FASD).

Premorbid difficulties. Children with diagnosed premorbid neurological, psychological or psychiatric impairment were excluded (Kerns et al., 1999; van't Hooft et al., 2003; 2007). For example, children with a history of infantile meningitis, intellectual disability or epilepsy, (or learning disabilities or premorbid ADHD in the case of the pTBI groups) were excluded from the study as these conditions could affect their attention over and above their TBI or ADHD.

Additional therapies. As was the case with Tamm et al.'s (2010) research on 'Pay Attention!', children receiving other cognitive rehabilitation such as CogMed were not eligible to participate. However children receiving conventional rehabilitation such as speech or occupational therapy were still eligible, as attention is not specifically being trained in those interventions. If children were receiving additional therapies or were on medication

such as Ritalin, parents were requested to keep the therapies consistent (as far as possible) throughout the duration of the study.

Comorbidities. For the ADHD Intervention Group, I sought children who had no other comorbid diagnoses, as additional behavioural or psychiatric difficulties could affect cognition in various ways. However, as was found to be the case when contacting LSEN schools, as well as in Tamm et al.'s (2010) study, most children diagnosed with ADHD have at least one comorbid disorder such as a learning disorder, Oppositional Defiance Disorder (ODD), epilepsy, conduct disorders, anxiety and depression (Gillberg et al., 2004; Guerts et al., 2008; Jonsdottir, Bouma, Sergeant, & Scherder, 2006; Larson, Russ, Kahn, & Halfon, 2011). ODD has been reported as the most common comorbidity of ADHD, occurring in approximately 60% of cases (Connor, Steeber, & McBurnett, 2010; Rommelse et al., 2009). Therefore, one child was accepted into the study that had a comorbid diagnosis of ODD.

A description of the demographic details of the final sample are presented in the results section of this thesis.

Measures and apparatus

The intervention under investigation is now discussed in detail, followed by a description of the neuropsychological assessments used.

'Pay attention!'. There are four different tasks in the program: Card Sort, House Search, Card Flip and Attention CD. The first three tasks train attention in a visual modality, whereas the Attention CD trains attention in an auditory modality. The same four tasks are used across each attentional domain, but are adjusted to suit each domain. Each task also has various parameters or stimuli that are used to make the task more difficult.

In the Card Sort task in the sustained attention domain, participants are required to use given criteria to sort the family cards into piles (e.g. according to hair colour or accessories worn). When the child is able to do this, the task is made more difficult by asking the child to sort the cards based on multiple criteria (e.g. blonde hair and glasses). In the selective attention domain when the card sorting task is used, distracting sounds are played in the background (e.g. heartbeat or a baby crying). In the alternating attention domain, the child is required to switch sorting tasks at the administrator's instruction (e.g. glasses vs. no glasses and hats vs. no hats). Lastly, in the divided attention domain, the participant is given two tasks to do simultaneously (e.g. sorting the cards into different families and placing the cards with boys on them face down).

In the House Search task, in the sustained attention domain, children are presented with a house stimulus and asked to find targets as quickly as they can by marking an X on these items as they are found (e.g. all the green things). The task becomes increasingly difficult as multiple targets need to be found (e.g. all the animals and books). In the selective attention domain, children are still required to find targets, however distracting overlays are placed over the house stimuli (e.g. curved or intersecting lines). In the alternating attention domain, children need to switch between finding two different targets at the administrator's instruction. In the divided attention domain, distracting sounds are played while the child finds the target stimuli.

In the Card Flip task, for the sustained attention domain, the administrator presents the child with one card at a time, and the child has to press a clicker when they see target stimuli (e.g. someone wearing glasses). The target stimuli become increasingly difficult to find (e.g. a child followed by a grandparent). In the selective attention domain, the same task is executed however auditory distractors are played in the background (e.g. a phone ringing or children laughing). In the alternating attention domain, the child has to switch between responding to two different stimuli at the administrator's instruction. In the divided attention domain, the child has to respond to stimuli by pressing the clicker, at the same time as doing the activities played on the Attention CD.

In the Attention CD task in the sustained attention domain, participants are required to press the clicker when they hear a target stimuli (e.g. when they hear the colour red when a list of colours is read). The tasks become increasingly difficult (e.g. when they hear either red or yellow they must press the clicker). In the selective attention domain, participants are required to do the same task again but while auditory distractors are played in the background (e.g. people talking or laughing). In the alternating attention domain, children have to press the clicker when they hear a certain target, and then at the administrator's instruction, switch to listening for a different target. In the divided attention domain, children are required to press the clicker when they hear a target word and at the same time they need to sort cards into piles.

Participants' progression from one exercise to the next is based on two criteria: number of errors and task completion time. When participants' number of task errors decrease or their task completion time improves, while achieving 90-100% accuracy across three consecutive sessions, then the trainer can procede to the next task which increases in difficulty. No session trains more than two attention components at a time, and children are

not required to complete all tasks in the training manual. Children progress as far as they can within the allocated time for the intervention (Thomson et al., 2005).

The authors of 'Pay Attention!' state that "repeated activation and stimulation of brain systems responsible for attention is hypothesized to facilitate changes in cognitive capacity, which presumably reflect underlying changes in neuronal activity" (Thomson et al., 2005, p.2). The authors therefore argue that the effects of training should be evident in three domains (Thomson et al., 2005): task training performance, psychometric assessments, and a measure of every day attentional tasks.

Pre- and post-test measures. At pre-test, parents or caregivers of participants were required to complete a demographic questionnaire that assesses demographic information, SES background and asset index (Appendix G). The Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) was administered only at pre-test to assess children's baseline IQ.

In order to assess attention pre- and post-intervention, the following tests were administered: Sky Search, Score!, Same World/Opposite World, and Sky Search DT from the Test of Everyday Attention for Children (TEA-Ch) (Manly, Robertson, Anderson & Nimmo-Smith, 1999), as well as The Conners' Continuous Performance Test II (CPT-II; Conners & MHS Staff, 2000). Because attention is intrinsically linked to other cognitive domains, I included tests of higher order attentional skills and memory in the battery. The Numbers subtest from the Children's Memory Scale (CMS; Cohen, 1997) was used to assess attention and working memory, and the Inhibition subtest from the NEPSY-II was used to assess inhibition (Korkman, Kirk, & Kemp, 2007). Verbal and visual memory was assessed using the Word List and Dot Locations subtests from the CMS, respectively (Cohen, 1997).

In terms of behavioural measures, parents and teachers were asked to complete the Behaviour Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) and the Child Behaviour Checklist (CBCL; Achenbach & Edelbrock, 1983), and parents were also asked to complete the Vineland Adaptive Behaviour Scales-II (VABS-II; Sparrow, Cicchetti, & Balla, 2005) pre- and post-intervention.

Each of these measures were chosen because they have previously been used in research to assess the efficacy of 'Pay Attention!' which is based on Sohlberg and Mateer's (2001) model, or because they are commonly used to assess attention in children with pTBI, and/or because they have been used reliably in South African research. For a full review of all measures used in the study, please refer to Appendix H.

Procedure

Pre-testing procedure. All participants were tested on the neuropsychological battery described above by neuropsychology Masters students and interns who were blind to group allocation. Testing took place either at UCT or RXH at a time convenient for participants, and dependent on room availability. The rooms that were used were small, quiet and had minimal distractions. Parents were required to sign a letter of consent (Appendix I and J), and children were required to sign a letter of assent (Appendix K) before being administered the various tests and questionnaires. I explained to parents that their child would be invited to participate into the study if they met all inclusion and exclusion criteria identified for the study.

Pre-testing took approximately 3 hours. Breaks were given when necessary, and in some cases the assessment took place over two days if the assessor felt that the child was overly fatigued. Refreshments were provided for both children and parents. Pre- and post-testing took place within 4 weeks of beginning and completing the program (Tamm et al., 2010; 2013).

TBI sample. Neuropsychology interns (Masters level) administered the pre- and post-neuropsychological tests for the TBI sample. The interns were required to conduct a "mock assessment" on a healthy child under direct supervision before assessing the participants. In cases where English was not the child's first language, an experienced interpreter, who works in a clinical setting, was present. I conducted a brief history taking with the parents/caregivers at the same time as the children were being assessed, to confirm that the children met the inclusion and exclusion criteria for the study. I also gave the parents/caregivers the three measures to complete (i.e. BRIEF, CBCL, VABS-II). Although these are all self-administered measures, I was present to answer any questions the parents/caregivers had, and an isiXhosa interpreter was present for those who were not first-language English speakers.

ADHD sample. I conducted the pre-assessments for all children diagnosed with ADHD, while a Clinical Psychology Master's student conducted the history taking with child's parents/caregivers. This Clinical Psychology Master's student also administered the 'Pay Attention!' intervention with these children. The aim was to reduce bias in the testing, as the same person did not assess and administer the intervention with this group of children.

Teachers. If a child met the criteria to participate in the study, and with parental consent, I faxed or e-mailed the teacher forms (CBCL and BRIEF) to the child's school. I

then called teachers to confirm receipt of the forms and to remind teachers to complete and return them. All forms were returned with the exception of three. Two teachers of children from the TBI Intervention Group (from the same school) did not consent to participating in the study. One teacher did not return her forms as the child (who was assigned to the TBI Art Group) had withdrawn from the study.

Many of the forms were returned with missing or illegible answers. Every effort was made to collect the missing data, but in some cases the teacher reported s/he was too busy and would not assist further.

Allocation to groups. Upon completion of the pre-testing, the children who had sustained a TBI were divided into groups, and then the five ADHD children were recruited to match the TBI Intervention Group.

TBI groups. It was soon realised that it would be very difficult to randomly assign children to groups, as not all children would cope in the intervention group if they were not fully proficient in English. Therefore, my supervisor and I chose the five children most proficient in English and allocated them to the TBI Intervention group. The remaining ten children were divided into 2 groups and matched based on age, sex, time since injury and severity of injury. One of those two groups was randomly assigned to be the TBI Art Group, and the other group was randomly assigned to be the TBI Control Group.

ADHD group. I recruited these children to match the TBI intervention group on sex. The first five children with diagnosed ADHD who were assessed and met all criteria were included in the study. Given the difficulties with recruitment and the time constraints, I used these five children even though they were not all matched to the TBI Intervention Group on age. Given the small age range, it was not expected that the mean age would differ significantly.

Intervention phase

The TBI Intervention Group and the ADHD Intervention Group. The Clinical Psychology Masters student and I received training on the program by Dr. Leigh Schrieff-Elson, our research supervisor, who has obtained her doctorate with research on the program. The Clinical Psychology Masters student and I did not administer any of the pre- or post-tests.

In the majority of the previous studies on ‘Pay Attention!’, researchers have administered the program twice a week for 25-30 minutes for eight-to-ten weeks (Chenault et al., 2006; Kerns et al., 1999; Tamm et al., 2010), and Schrieff (2013) conducted 45-minute

sessions, twice a week, for 10 weeks. The intervention in this study ran for 45 minutes twice a week for a period of 12 weeks. It was hypothesised that increasing the length of the intervention may show stronger end results.

The children in the TBI Intervention Group resided predominantly in township areas and attended schools that were not close to each other. Due to the time-consuming nature of the program, it was not viable for me to travel to each child's school to implement the intervention. I therefore asked parents to bring their children to RXH during the week or to UCT on the weekends for the duration of the program. RXH is centrally located and easily accessible via public transport. If I was meeting a participant at UCT and they did not have their own transport I would pick them up from a nearby bus stop or taxi rank. Participants were seen at a regular agreed-upon time, one-on-one, in a quiet room. If a participant missed a session, every effort was made to make it up.

Two participants in the ADHD sample attended the same school and so the Clinical Psychology Master's student was able to implement the intervention at their school. For the other three children, the Clinical Psychology Master's student implemented the intervention at UCT.

TBI Art Group. A HPCSA registered Clinical Psychologist agreed to run the group for a small fee. The Clinical Psychologist had been trained in art therapy and has experience with children.

My supervisor and I advertised 5 research RAs positions to the third year and honours classes at UCT. The Clinical Psychologist and I interviewed applicants and chose the 5 students who appeared most experienced with children and committed to the project. These students were then approved by my supervisor. The Clinical Psychologist ran an Introduction to Art Therapy workshop for all five RAs. Each RA was then assigned a child that they would see every week under the supervision of the Clinical Psychologist. Each child would therefore receive the one-on-one attention to mirror the intervention groups, however this group took place in a group setting so that it could be supervised.

As with the intervention groups, parents were asked to bring their children to the RXH for a 45-minute session, twice a week for a period of 12 weeks. If a session was missed, then individual or group makeup sessions were arranged.

TBI Control Group. In this group, children were tested on the neuropsychological battery at the same times as the TBI Art-Group and Intervention Groups. However, they received no intervention or contact between the two test dates.

Post-test assessments. The post-test assessments for all four groups followed the same format as the pre-assessments. Once again, testers were blind to the participants' group membership at post-testing, and did not test the same child at both pre- and post-testing sessions. I, too, did not administer post-tests to any children. Post-testing took approximately 2 ½ hours.

Data Analysis

All neuropsychological test data was analysed using SPSS 20.0.

Demographic data. First, Levene's test of homogeneity and the Shapiro-Wilk test for normality were used to assess whether assumptions underlying parametric analyses were upheld or not. Between-group differences on continuous demographic variables were examined using ANOVAs or the Kruskal-Wallis *H* test, depending on whether the aforementioned assumptions were upheld or not. Chi-square or Fisher's exact test were used to examine the categorical variables. Fisher's exact test was used in cases where the sample size was particularly small and where the cells of the variables had expected counts less than 5 (Field, 2009; Stangor, 2011).

In instances where significant differences were found throughout all analyses, I used Tukey's post-hoc test for parametric data, or Mann-Whitney U test for nonparametric data, in order to determine where the differences lie (Field, 2009; Stangor, 2011).

Deriving and comparing composite scores. Due to the large number of dependent variables in comparison to the small sample size, a hybrid method using composite scores was used (see Ferrett et al. 2010; Medina et al., 2007). In order to do this, the test battery was sorted into composite domains, based on theoretical assumptions and established categorizations. The Cronbach alpha coefficients were then calculated to ensure that the tasks considered similar and thus grouped in each domain, were indeed correlated. Individual neuropsychological test variables were then converted to z-scores, based on $n = 20$. These z-scores were then averaged to yield a final composite z-score for each domain (Medina et al., 2007).

Pre- and post-test between- and within-group comparisons. The composite scores were then used to run between-group comparisons pre-and post-treatment. ANOVAS (parametric) and Kruskal-Wallis *H* (nonparametric) tests were used for the between-group comparisons and the Wilcoxon signed-rank test was used for within-group comparisons, in cases where parametric assumptions were not met (Field, 2009; Stangor, 2011).

I did not use a Bonferroni correction for the analyses. Public health researchers

consider controlling for Type II errors (i.e. missing important information) more concerning than strictly controlling for alpha values (Jacobson & Jacobson, 2005). Applying a Bonferroni correction on such a small sample size may underestimate any significant results found on the outcome measures.

Individual change. The Reliable Change Index (RCI; Jacobson & Traux, 1991) was used to determine if changes in the individual participant's scores from pre-test to post-test were clinically significant. This measure distinguishes scores that have changed due to practice/carryover effects. RCI scores were calculated by a reliable change generator software program (Devilly, 2004) that is based on Jacobson and Traux's (1991) model.

Pre- and post-test scores, all subtest test-retest reliability coefficients, as well as the reported standard deviation of the normative sample for the specific subtest were inputted into the program, to produce an RCI score. The reliable change generator produces three levels of change at the 68.26%, 95% and the 99% confidence intervals. Scores of above 1.96 indicate a significant difference between pre- and post-test scores at the 95% confidence interval.

The RCI is based on the following formula:

$SEd = \sqrt{2}(Se)^2$, where $Se = s(\sqrt{1} - rxx)$,

where *s* is the standard deviation, r*xx* is the test-retest reliability coefficient, and *SEd* is the standard error of difference of the change from the time of pre-test to the time of post-test (Jacobson & Traux, 1991).

The RCI scores were then compared descriptively.

Ethical Considerations

UCT's Department of Psychology Research Ethics Committee as well as the UCT Faculty of Health Sciences Human Research Ethics Committee granted ethical approval for this study (Appendix A). The WCED gave permission to recruit children through the schools and use school facilities to implement the intervention (Appendix D). RXH gave permission to recruit children through the hospital and use hospital facilities to conduct the intervention (Appendix E).

Informed consent and assent. Parents/guardians were required to sign a letter of consent (Appendix I and J), and children were required to sign a letter of assent (Appendix K) before pre-testing commenced. Parents and teachers also signed consent after the children were accepted into the study and allocated to a group (Appendix L, M, N and O), and children signed a letter of assent relevant to the assigned group (Appendix P, Q, R and S).

Confidentiality, voluntary participation and deception. Children and parents were informed that participation in the study was entirely voluntary, and that they could withdraw from the study at any time without disclosing a reason. I emphasised to participants that should they choose to withdraw from the study, that they would not incur a penalty from the hospital or school, and that their academic experience and medical treatment would not be disadvantaged by their withdrawal. No deception was used in this study.

All data collected from children, parents/guardians and teachers would remain confidential and would only be used for research purposes. Anonymity of participants was preserved. Participants' names were not written on the neuropsychological tests in order to further protect them. Each participant was assigned a number, and the code sheet has been stored separately to the tests, and only made accessible to my supervisor and I. All data has been stored in a locked cupboard, to which only my supervisor and I have access.

Risks and benefits. There were no social, emotional or physical risks to participants in the study. Some participants may have experienced fatigue during the assessments or the intervention, however breaks and refreshments were given as needed.

Parents received compensation for travel expenses each time they came for an assessment and each time they came for the cognitive rehabilitation or art therapy session (between R50 and R100). Parents were also given feedback and a brief neuropsychological report on the assessments, and therefore gained a deeper understanding of their child's functioning.

Children in the art therapy group took home their craft at the end of each session, and children in the Intervention Groups took home a star chart at the end of each session. With parental consent, children also received a sweet of their choice at the end of each session.

Wait-listed control group. A control group that receives no treatment is understood to be ethically acceptable under four conditions: if the efficacy of the treatment is unknown, if the treatment is undergoing validation, if sufficient resources are unavailable, and if the treatment is made available to the control group once it has been proven efficacious (South African Medical Research Council, 2001). This research met all four criteria.

Results

Sample Demographic and IQ Characteristics

Table 2 shows that all participants were evenly matched on their age at the pre-test (small effect size) and sex. Participants in the three TBI groups were matched on their GCS at the time of admission to hospital (small effect size), as well as the mechanism of their injury. No significant differences were found between groups on performance IQ (PIQ; moderate effect size).

Significant differences were, however, found for time since injury, attendance, race, home language, verbal IQ (VIQ) and full scale IQ (FSIQ). Post hoc Tukey analyses show that the TBI Control Group's injuries were sustained more recently compared to the TBI Intervention Group (p = .032). Mann Whitney post-hoc analyses indicate that the TBI Intervention Group attended significantly more sessions than the ADHD Intervention Group, with a moderate effect size (U =3.50, p =.040, r =.55*).* Individual chi-squared analyses showed that there was a significant difference in race between the ADHD Intervention Group and the TBI Intervention Group (χ^2 = 7.81, p = .008), the TBI Art Group (χ^2 = 7.81, p = .008), and the TBI Control Group (χ^2 = 6.68, p = .048). Individual chi-squared analyses also showed a significant difference in home language between the TBI Art Group and the ADHD Intervention Group (χ^2 = 12.37, p = .008), as well as between the TBI Art Group and the TBI Intervention Group (χ^2 = 12.37, p = .008). Although significant differences were found between the four groups in VIQ with a moderate effect size (p = .044, r = .41), Tukey's post-hoc analyses showed no significant differences between groups. Lastly, Tukey's post hoc analyses showed that the ADHD Intervention Group had significantly higher FSIQ scores compared to the TBI Intervention Group (p = .032), TBI Art Group (p = .040) and TBI Control Group (p = .030).

Table 3 illustrates that all participants were evenly matched on annual household income, and parental/guardian education and employment. However, a significant difference was found between groups on SES. Individual chi-squared analyses showed the significant difference lies between the ADHD Intervention Group and TBI Art Group (χ^2 = 9.00, p = .008).

Table 2

Demographic and IQ Characteristics of the Sample (N =19)

	Group				Statistics			
	TBI Intervention Group (*n* = 5)	TBI Art Group (*n* = 4)	TBI Control Group (*n* = 5)	ADHD Intervention Group (*n* = 5)	*F/ H/*χ^2	*df*	*p*	*r*
Age at pre-test[a]	77.40 (6.84)	96.25 (7.54)	91.20 (2.39)	87.60 (15.08)	6.77[b]	3	.080[c]	.32
Time since injury[a]	51.20 (7.66)	50.00 (2.58)	34.40 (12.58)	N/A	5.29	2	.025*	.49
GCS	9.40 (4.34)	8.50 (1.73)	8.80 (3.49)	N/A	.08	2	.924	.01
Attendance	21.60 (2.07)	18.75 (.50)	N/A	17.00 (3.74)	5.79[b]	2	.046*	.45
Sex								
Male: Female	4:1	2:2	3:2	4:1	1.60[d]	3	.779	
Race								
Black: White: Coloured[e]: Indian	0:0:3:2	4:0:0:0	4:0:1:0	0:3:2:0	18.91[d]	9	<.001***	
Injury Mechanism								
MVA pedestrian: MVA passenger	3:2	4:0	4:1	N/A	1.89[d]	2	.725	
Home Language								
Xhosa: English	0:5	4:0	3:2	0:5	12.64[d]	3	.002**	
VIQ	73.60 (6.84)	75.25 (10.01)	77.00 (10.49)	95.20 (17.54)	3.45	3	.044*	.41
PIQ	86.00 (9.22)	82.75 (5.80)	81.80 (12.87)	101.80 (17.12)	2.79	3	.076	.36
FSIQ	77.40 (6.95)	77.00 (7.57)	77.20 (11.05)	98.40 (14.57)	4.86	3	.015*	.49

Note. For *age at pre-test, time since injury, GCS, attendance, VIQ, PIQ,* and *FSIQ,* means are presented with standard deviations in parentheses. [a]For *age at pre-test* and *time since injury,* data are presented in months. [b]Kruskal-Wallis *H* statistic. [c]Exact level of significance not given, only asymptotic. [d]Chi-squared χ^2statistic. [e] A racial category used in South Africa for persons of mixed ancestry. GCS = Glasgow Coma Score; VIQ = Verbal IQ; PIQ = Performance IQ; FSIQ = Full Scale IQ. The *r* value here is an estimate of effect size. *p = < .05. **p < .01. ***p < .001.

Table 3

Demographic Questionnaire and Asset Index (N = 19)

	Group				
	TBI Intervention Group (*n* = 5)	TBI Art Group (*n* = 4)	TBI Control Group (*n* = 5)	ADHD Intervention Group (*n* = 5)	*p*
Household income per year					.198
0	-	-	-	-	
1 – 5 000	0	1	0	0	
5 001 – 25 000	2	2	1	1	
25 001 – 100 000	1	1	4	4	
100 001+	2	0	0	0	
Parental education (father: mother: guardian)					.406; 1.000; 1.000
0 years	-	-	-	-	
1 -6 years	0:0	0:0	0:0	2:0	
7 years	-	-	-	-	
8 – 11 years	3:3	1:2	2:3	0:2	
12 years	1:1:1	2:1	3:2	1:2	
13+ years	0:0	0:1	0:0	1:1	
Don't know	1:0	1:0	0:0	1:0	
Parental employment (father: mother: guardian)					.163; .627; 1.000
Higher executives, major professionals	-	-	-	-	
Business managers of medium businesses, lesser professions	0:0	0:0	0:0	3:2	
Administrative personnel, managers, minor professionals	0:0	1:0	1:0	0:1	
Clerical and sales, technicians, small businesses	1:0	1:0	1:1	1:0	
Skilled manual (with training)	1:1	0:0	3:0	1:0	
Semi-skilled	0:0	0:0	0:0	0:0	
Unskilled, unemployed	2:0	1:1	0:1	0:0	
Homemaker	0:2:1	0:3	0:3	0:2	
Student, no occupation	0:1	1:0	0:0	0:0	
Unknown	-	-	-	-	
Material and financial resources (Asset Index)					.026*
0-5 assets (low)	-	-	-	-	
6-12 assets (medium)	2	3	3	0	
13-17 assets (high)	3	1	2	5	

Note. [a]Presented in South African Rands (ZAR). At the time of the study, the US$: ZAR exchange rate was 1 : 9.00. *p = < .05.

Pre-Intervention Between-Group Comparisons

Cognitive measures. For a list of all the subtests that comprise the composites, refer to Appendix T. Table 4 illustrates that no significant differences were found on the cognitive measure composites at pre-test. When I ran individual subtest analyses (Appendix U), I found a significant difference on the time taken to complete the Same World subtest ($p = .017$). However, Tukey's post-hoc comparisons showed no significant differences between groups on this measure.

Behavioural measures. Only one significant difference was found on between-group comparisons on behavioural measures (BRIEF, CBCL and VABS-II for parents, and BRIEF and CBCL for teachers) at pretest. Table 5 illustrates that a significant difference was found for the Somatic Complaint item of the CBCL parent report ($p = .021$) with a moderate effect size ($r = .47$). Post hoc Mann Whitney analyses showed that the ADHD Intervention Group scored significantly lower on this measure compared to the TBI Intervention Group ($U = 3.00$, $p = .028$, $r = .60$), TBI Art Group ($U = 1.00$, $p = .024$, $r = .66$), and the TBI Control Group ($U = 2.50$, $p = .024$, $r = .62$), all with moderate effect sizes. For the full pre-test behavioural measure analyses, refer to Appendix V, W, X, and Y.

Table 4

Between-group Analyses for Neuropsychological Test Composites at Pre-test: TBI Intervention Group vs. Control Groups (N = 19)

	Groups												Test statistics		
	TBI Intervention Group (*n* = 5)			TBI Art Group (*n* = 4)			TBI Control Group (*n* = 5)			ADHD Intervention Group (*n* = 5)					
Composite variable	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*F/H*	*p*	*r*
Sustained attention (α = .70)	.00 (.32) [c]	-.39-.34	8.50	-.07 (.38)	-.28-.50	7.00	.13 (.16) [b]	-.04-.26	11.00	-.08 (.39)	-.66-.31	8.20	1.24	.772	.17
Selective attention (α = .67)	.26 (.83)	-1.16-.86		-.43 (.53)	-1.08-.12		-.33 (.83)	-1.23-.86		.42 (.75)	-.34 - 1.41		1.45	.267	.23
Attentional control	4.20 (3.03)	2-8	11.60	1.50 (1.00)	1-3	5.38	2.75 (2.06)[c]	1-5	8.38	4.60 (3.36)	1-9	11.60	4.32 [a]	.241	.16
Divided attention	2.00 (2.24)	1-6	9.80	1.50 (1.00)	1-3	10.00	2.40 (3.13)	1-8	10.10	2.40 (3.13)	1-8	10.10	.02[a]	1.000	.92
Inhibition (α = .93)	.06 (1.16)	-1.26-1.28		-.50 (.82)	-1.38-.51		-.11 (1.07)[c]	-1.51-1.04		.42 (.88)	-1.00-1.30		.66	.590	.12
Working memory	5.33 (1.53)[b]	4-7	5.00	5.33 (3.06) [b]	2-8	5.83	7.00 (3.27)[c]	3-11	8.00	8.80 (2.59)	6-13	11.10	4.53 [a]	.219 [a]	.18
Verbal memory (α = .91)	.10 (.96)	-.61-1.66		-.69 (.34)	-1.01--.22		-.04 (1.19)	-.99-1.89		.49 (.83)	-.48-1.63		1.27	.321	.20
Visual memory (α = .82)	-2.68 (.44)	-.62-.47		.02 (.94)	-.72-1.34		-.38 (.88)	-1.16-.69		.63 (.99)	-.52-1.67		1.46	.266	.23

Note. [a]Kruskal Wallis H statistic. [b]*n* = 3, [c]*n* = 4. Composites were calculated using z-scores but domains with only one test (attentional control, divided attention, working memory) were calculated using scaled scores. The *r* value here is an estimate of effect size.

Table 5

Between-group Analyses for CBCL Parent Report at Pre-test: TBI Intervention Group vs. Control Groups (N = 19)

CBCL syndrome profile	Groups												Test statistics		
	TBI Intervention Group (*n* = 5)			TBI Art Group (*n* = 4)			TBI Control Group (*n* = 5)			ADHD Intervention Group (*n* = 5)					
	M(SD)	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*F/H*	*p*	*r*
Anxious/depressed	54.80 (4.71)	51-62		58.00 (7.79)	51-67		59.80 (5.07)	53-66		63.40 (6.07)	54-70		1.85	.182	.27
Withdrawn/depressed	63.20 (10.83)	50-76		65.00 (8.87)	56-76		67.00 (7.87)	56-76		58.40 (8.99)	50-70		.78	.521	.14
Somatic complaints	63.20 (4.76)	57-70	10.20	69.50 (6.81)	64-78	14.63	65.60 (7.23)	57-74	11.80	54.00 (5.79)	50-64	4.30	8.65 [a]	.021 [*]	.47
Attention/problems	66.00 (8.03)	57-79		70.25 (19.59)	55-96		64.00 (12.15)	50-83		66.80 (3.96)	61-71		.22	.884	.04
Rule-breaking behaviour	59.20 (6.61)	52-67	10.50	57.75 (12.39)	50-76	8.38	63.40 (10.14)	50-72	12.60	55.40 (5.41)	50-64	8.20	1.98 [a]	.604	.06
Aggressive behaviour	66.60 (5.23)	62-75		70.00 (11.80)	60-87		66.60 (12.82)	50-79		66.60 (9.48)	52-78		.12	.948	.02
Internalizing problems	61.20 (8.01)	50-71	7.80	65.50 (8.70)	58-74	12.00	66.80 (2.17)	63-68	12.60	61.20 (7.53)	50-68	8.00	3.01 [a]	.412	.05
Externalizing behaviour	65.20 (4.32)	60-70	10.10	65.25 (9.32)	59-79	9.38	64.40 (12.34)	49-74	10.90	63.40 (9.02)	49-73	9.50	.22 [a]	.978	.46
ADHD problems	63.40 (5.81)	58-70		67.25 (8.62)	60-77		62.60 (11.10)	50-75		69.00 (4.64)	62-75		.73	.548	.13

Note. [a]Kruskal Wallis H statistic. CBCL = Child behaviour checklist. ADHD = Attention Deficit Hyperactive Disorder. The *r* value here is an estimate of effect size. *p = < .05.

Pre- and Post-intervention Within-group Analyses

No significant differences were found within-groups on cognitive measures (Appendix Z).

With regards to the behavioural measures, Table 6 shows that both TBI and ADHD Intervention Groups made significant improvements on the Attention and ADHD subscales of the CBCL parent-report compared to controls (p = .031 for all analyses). The TBI Control group had significantly better externalizing behaviours on this measure compared to other groups at post-test (p = .031). In addition, Table 7 shows that participants in the TBI Intervention Group improved on the VABS-II personal and domestic scales (p = .031). No other significant within-group differences were found across groups on the behavioural measures (refer to Appendix AA, BB, and CC).

Table 6

CBCL Syndrome Profiles: Within-group Comparisons for TBI Intervention Group and Control Groups from Pre- to Post-intervention (N = 19)

		TBI Intervention Group (*n* = 5)		TBI Art Group (*n* = 4)		TBI Control Group (*n* = 5)		ADHD Intervention Group (*n* = 5)	
		Range	M(SD)	Range	M(SD)	Range	M(SD)	Range	M(SD)
Anxious/depressed	Pre-intervention	51-62	54.80 (4.71)	51-67	58.00 (7.79)	53-66	59.80 (5.07)	54-70	63.40 (6.07)
	Post-intervention	50-54	52.60 (1.52)	50-66	59.00 (6.63)	50-64	57.00 (4.95)	54-69	62.60 (6.11)
	Z		-1.095		-.365		-1.095		-.736
	p		.188		.438		.188		.313
Withdrawn/depressed	Pre-intervention	50-76	63.20 (10.83)	56-76	65.00 (8.87)	56-76	67.00 (7.84)	50-70	58.40 (8.99)
	Post-intervention	50-76	58.00 (10.49)	62-70	65.00 (3.46)	50-76	63.00 (10.19)	50-66	57.60 (7.80)
	Z		-1.461		-.365		-.736		-1.000
	p		.125		.438		.438		.500
Somatic complaints	Pre-intervention	57-70	63.20 (4.76)	64-78	69.50 (6.81)	57-74	65.60 (7.23)	50-64	54.00 (5.79)
	Post-intervention	53-67	57.40 (5.73)	57-72	65.25 (6.19)	50-74	64.20 (8.79)	50-70	57.40 (7.64)
	Z		-1.841		-.736		-.365		-1.604
	p		.063		.313		.438		.125
Attention problems	Pre-intervention	57-79	66.00 (8.03)	55-96	70.25 (19.59)	50-83	64.00 (12.15)	61-71	66.80 (3.96)
	Post-intervention	55-66	59.80 (4.32)	51-88	67.75 (15.33)	50-61	54.80 (4.03)	55-61	58.20 (2.28)
	Z		-2.041		-.365		-1.826		-2.023
	p		.031*		.438		.063		.031*
Rule-breaking behaviour	Pre-intervention	52-67	59.20 (6.61)	50-76	57.75 (12.39)	50-72	63.40 (10.14)	50-64	55.40 (5.41)
	Post-intervention	51-59	55.40 (3.29)	51-77	61.50 (11.48)	50-74	60.60 (9.92)	50-67	57.60 (7.83)
	Z		-1.289		-1.633		-1.219		-1.289
	p		.188		.125		.125		.188
Aggressive behaviour	Pre-intervention	62-75	66.60 (5.23)	60-87	70.00 (11.80)	50-79	66.60 (12.82)	52-78	66.60 (9.48)
	Post-intervention	50-66	60.40 (6.19)	51-78	63.75 (12.09)	50-70	56.60 (8.17)	55-67	61.20 (5.36)
	Z		-1.483		-1.473		-1.826		-1.214
	p		.094		.125		.063		.156

Internalizing problems	Pre-intervention	50-71	61.20 (8.01)	58-74	65.50 (8.70)	63-68	66.80 (2.17)	50-68	61.20 (7.53)
	Post-intervention	41-68	54.40 (9.71)	54-72	64.00 (7.44)	33-71	59.80 (15.35)	50-70	61.60 (7.89)
	Z		-1.483		.000		-1.095		-.184
	p		.094		.625		.188		.500
Externalizing problems	Pre-intervention	60-70	65.20 (4.32)	59-79	65.25 (9.32)	49-74	64.40 (12.34)	49-63	63.40 (9.02)
	Post-intervention	46-65	58.20 (7.29)	51-77	62.50 (12.18)	34-73	54.60 (14.61)	51-67	59.60 (7.20)
	Z		-1.483		-.921		-2.023		-1.095
	p		.094		.250		.031*		.188
ADHD problems	Pre-intervention	58-70	63.40 (5.81)	60-77	67.25 (8.62)	50-75	62.60 (11.10)	62-75	69.00 (4.64)
	Post-intervention	51-68	59.20 (7.60)	51-69	61.50 (7.94)	50-62	54.60 (4.93)	55-69	60.00 (5.34)
	Z		-2.023		-1.461		-1.826		-2.023
	p		.031*		.125		.063		.031*

Note. CBCL = Child Behaviour Checklist. ADHD = Attention Deficit Hyperactive Disorder. *p = < .05.

Table 7

VABS-II Behavioural measures: Within-group Comparisons for TBI Intervention Group and Control Groups from Pre- to Post-intervention (N = 19)

		TBI Intervention Group (*n* = 5)		TBI Art Group (*n* = 4)		TBI Control Group (*n* = 5)		ADHD Intervention Group (*n* = 5)	
		Range	M(SD)	Range	M(SD)	Range	M(SD)	Range	M(SD)
Communication	Pre-intervention	29-50	35.80 (8.47)	25-48	36.75 (9.43)	28-50	39.00 (8.43)	31-55	42.00 (9.03)
	Post-intervention	25-55	41.00 (11.64)	33-53	41.50 (8.39)	23-56	39.80 (13.81)	32-52	43.00 (9.43)
	Z		-.677		-.730		.000		-.542
	p		.313		.313		.563		.344
Receptive	Pre-intervention	8-20	11.80 (4.92)	9-17	11.75 (3.59)	8-19	12.40 (4.10)	11-14	12.40 (1.14)
	Post-intervention	8-20	14.80 (4.76)	13-18	15.75 (2.63)	7-17	12.00 (3.72)	9-16	11.60 (2.70)
	Z		-1.095		-1.289		.000		-.816
	p		.188		.188		.563		.281
Expressive	Pre-intervention	10-19	13.80 (3.27)	9-15	12.25 (2.50)	8-18	12.00 (3.81)	10-23	16.20 (4.82)
	Post-intervention	7-19	14.80 (4.76)	10-17	12.50 (3.11)	10-20	15.40 (4.62)	13-23	18.20 (4.44)
	Z		-.552		-.184		-1.625		-1.289
	p		.375		.500		.094		.188
Written	Pre-intervention	7-12	10.20 (1.92)	7-16	12.50 (4.04)	7-22	14.60 (6.73)	9-20	13.60 (4.22)
	Post-intervention	8-16	11.40 (2.97)	8-18	13.25 (5.50)	6-19	12.40 (5.64)	10-17	13.20 (3.27)
	Z		-.816		-.368		-1.289		-.378
	p		.375		.375		.188		.500

Daily Living	Pre-intervention	34-48		39.00 (5.48)	27-44		37.25 (7.27)	33-59		44.00 (9.49)	30-70		43.60 (15.45)
	Post-intervention	34-61		43.40 (10.36)	31-43		38.25 (5.25)	23-58		41.20 (15.80)	33-64		49.40 (11.06)
	Z		-1.289			-.730			-.135			-1.084	
	p		.188			.313			.500			.188	
Personal	Pre-intervention	10-16		12.80 (2.59)	8-15		11.50 (2.89)	13-24		17.60 (4.67)	10-23		15.00 (4.95)
	Post-intervention	11-18		15.00 (3.24)	8-21		13.25 (5.50)	9-22		15.20 (6.38)	10-24		17.60 (5.18)
	Z	-2.060				-.447			-.677			-1.826	
	p	.031*				.500			.313			.063	
Domestic	Pre-intervention	10-16		13.00 (2.45)	10-16		13.50 (2.65)	11-14		12.80 (1.10)	12-23		15.40 (4.34)
	Post-intervention	12-20		15.40 (2.97)	12-14		13.00 (1.16)	7-19		12.40 (4.51)	12-20		15.80 (2.86)
	Z		-2.041			-.184			-.272			-.276	
	p		.031*			.500			.469			.500	
Community	Pre-intervention	11-16		13.20 (2.17)	9-17		12.25 (3.40)	8-24		13.60 (6.35)	11-24		15.20 (5.26)
	Post-intervention	4-24		13.00 (7.14)	10-15		12.00 (2.16)	7-22		13.60 (6.19)	11-20		16.00 (3.39)
	Z		.000			-.272			.000			-.552	
	p		.625			.500			.563			.375	
Socialization	Pre-intervention	26-64		44.00 (14.44)	20-46		31.75 (10.91)	31-54		39.60 (9.76)	37-58		45.40 (8.08)
	Post-intervention	24-71		42.80 (17.91)	29-49		40.50 (9.68)	28-62		43.40 (15.16)	45-51		48.00 (2.83)
	Z		-.730			-.730			-.405			-.944	
	p		.313			.313			.406			.219	

Interpersonal	Pre-intervention	8-21	15.20 (5.50)	5-16	9.50 (4.80)	8-19	12.00 (4.53)	13-19	15.40 (2.30)	
	Post-intervention	7-23	14.40 (6.47)	9-17	13.75 (3.59)	8-21	14.20 (5.63)	15-19	17.60 (1.67)	
	Z		.000		-1.095		-.674		-1.841	
	p		.563		.188		.313		.063	
Play	Pre-intervention	6-19	11.80 (5.07)	5-14	9.75 (4.03)	8-13	10.20 (2.17)	10-21	14.00 (4.36)	
	Post-intervention	5-24	12.60 (7.02)	10-15	13.00 (2.16)	8-21	13.80 (5.17)	12-17	14.00 (2.00)	
	Z		-.552		-1.841		-.736		.000	
	p		.375		.063		.313		.625	
Coping	Pre-intervention	12-24	17.00 (4.69)	10-18	12.50 (3.79)	9-23	17.40 (5.68)	14-18	16.00 (1.58)	
	Post-intervention	12-24	15.80 (4.82)	6-20	13.75 (5.91)	9-21	15.40 (5.60)	14-19	16.40 (1.95)	
	Z		-1.414		-.365		-.948		-.408	
	p		.250		.438		.188		.438	
Adaptive behaviour	Pre-intervention	56-85	67.80 (11.37)	62-100	80.25 (15.59)	79-112	90.60 (12.78)	29-98	75.20 (29.53)	
	Post-intervention	59-95	74.20 (13.85)	83-93	88.75 (4.35)	63-133	94.80 (29.77)	61-110	91.20 (18.95)	
	Z		-1.214		-.730		-.135		-1.214	
	p		.156		.313		.500		.156	

Note. VABS-II = Vinelands Adaptive Behaviour Scale – Second Edition. *p = < .05

Post-intervention Between-group Analyses

The subtests that comprise the post-test composites were the same as in the pre-test (refer to Appendix DD). Table 8 shows that no significant differences were found for between-group comparisons of the neuropsychological test composites. However, individual between-group analyses on the subscales indicate a significant difference between groups on Word List Learning (p = .033) and Word List Delayed Recognition (p = .027; Appendix EE). Mann Whitney post-hoc analyses showed that on both subscales, the ADHD Intervention Group performed significantly better post-intervention compared to the TBI Intervention Group (U = .000, p = .008, r = .76) and the TBI Art Group (U = .000, p = .014, r = .73), with large effect sizes.

In terms of behavioural measures, Table 9 shows a significant difference was found between groups on the Anxious/Depressed subscale of the Parent CBCL at post-test. A Mann Whitney post-hoc analysis indicated that the ADHD Intervention group scored significantly higher on this subscale compared to the TBI Intervention Group, with a large effect size (U = .500, p = .008, r = .76). A significant difference was also found on the Working Memory subscale of the BRIEF teacher report at post-test (Appendix FF). Mann Whitney post-hoc analyses showed that the TBI Art Group had improved working memory compared to the ADHD Intervention Group (U = .000, p = .018, r = .70). However, this finding should be interpreted with caution as only three teachers from the TBI Art Group returned their forms.

No other significant between-group differences were found on the behavioural measures at post-test (refer to Appendix GG, HH, and II).

Table 8

Between-group Analyses for Neuropsychological Test Composites at Post-test: TBI Intervention Group vs. Control Groups (N = 19)

	Groups												Test statistics		
	TBI Intervention Group (*n* = 5)			TBI Art Group (*n* = 4)			TBI Control Group (*n* = 5)			ADHD Intervention Group (*n* = 5)					
Composite variable	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*F/H*	*p*	*r*
Sustained attention (α = .71)	.08 (.25)	-.17-.36	11.80	.02 (.52)	-.50-.68	8.75	-.04 (.28)[c]	-.31-.26	8.50	-.03 (.43)	-.36-.73	8.60	1.29	.760	.16
Selective attention (α = .72)	.00 (1.09)	-1.22-1.19	10.00	-.42 (.45)	-1.06--.04	6.75	-.04 (.66)[c]	-.48-.93	7.75	.37 (.90)	-.26-1.92	12.60	3.22[a]	.359[d]	.08
Attentional Control	4.40 (4.34)	2-12	9.90	3.25 (2.63)	1-6	7.75	4.60 (3.36)	1-8	10.20	5.8-(3.83)	1-11	11.70	1.13	.791	.19
Divided attention	1.60 (1.34)	1-4	8.40	4.25 (4.27)	1-10	11.88	2.00 (2.00)[c]	1-5	9.13	2.00 (2.24)	1-6	9.00	1.71[a]	.706	.12
Inhibition (α = .84)	-.31 (.79)	-1.26-.52		-.38 (.69)	-1.26-.25		.04 (1.09)	-1.26-1.05		.56 (1.01)	-1.00-1.74		1.03	.408	.17
Working memory	7.25 (2.22)[c]	4-9	8.75	7.50 (.58)	7-8	8.00	8.00 (4.30)	2-13	9.20	10.40 (4.45)	5-16	11.60	1.22	.774	.17
Verbal memory (α = .93)	-.45 (.30)	-.75-.03	7.70	-.46 (.20)	-.66-.21	7.88	-.19 (1.08)	-1.30-1.34	7.40	1.26 (.51)[c]	.78-1.82	16.00	7.65[a]	.054[d]	.37
Visual memory (α = .87)	-.69 (.99)	-1.53-.82		.11 (.67)	-.63-.94		-.05 (1.09)	-1.79-.94		.81 (.48)[c]	.11-1.19		2.20	.133	.32

Note. [a]Kruskal Wallis H statistic. [b] *n* = 3, [c]*n* = 4. [d]Exact level of significance not given, only asymptotic. Composites were calculated with z-scores but domains with only one test (attentional control, divided attention, working memory) were calculated using scaled scores. The *r* value here is an estimate of effect size.

Table 9

Between-group Analyses for CBCL Parent Report at Post-test: TBI Intervention Group vs. Control Groups (N = 19)

	Groups								Test statistics		
	TBI Intervention Group (n = 5)		TBI Art Group (n = 4)		TBI Control Group (n = 5)		ADHD Intervention Group (n = 5)				
CBCL syndrome profile	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*F/H*	*p*	*r*
Anxious/depressed	52.60 (1.52)	50-54	59.00 (6.63)	50-66	57.00 (4.95)	50-64	62.60 (6.11)	54-69	7.59[a]	.043*	.39
Withdrawn/depressed	58.00 (10.49)	50-76	65.00 (3.46)	62-70	63.00 (10.20)	50-76	57.60 (7.80)	50-66	.81	.506	.14
Somatic complaints	57.40 (5.73)	53-67	65.25 (6.19)	57-72	64.20 (8.79)	50-74	57.40 (7.64)	50-70	1.60	.231	.24
Attention/problems	59.80 (4.32)	55-66	67.75 (15.33)	51-88	54.80 (4.03)	50-61	58.20 (2.28)	55-61	2.26	.124	.31
Rule-breaking behaviour	55.40 (3.29)	51-59	61.50 (11.48)	51-77	60.60 (9.92)	50-74	57.60 (7.83)	50-67	.51	.681	.09
Aggressive behaviour	60.40 (6.19)	50-66	63.75 (12.09)	51-78	56.60 (8.17)	50-70	61.20 (5.36)	55-67	.62	.617	.11
Internalizing problems	54.40 (9.71)	41-68	64.00 (7.44)	54-72	59.80 (15.35)	33-71	61.60 (7.89)	50-70	2.42[a]	.491[b]	.00
Externalizing behaviour	58.20 (7.29)	46-65	62.50 (12.18)	51-77	54.60 (14.61)	34-73	59.60 (7.20)	51-67	.43	.737	.08
ADHD problems	59.20 (7.60)	51-68	61.50 (7.94)	51-69	54.60 (4.93)	50-62	60.00 (5.34)	55-69	.99	.424	.17

Note. [a]Kruskal Wallis H statistic; for Anxious/depressed mean rank of TBI Intervention Group = 4.90, TBI Art Group = 11.50, TBI Control Group = 9.50, and ADHD Intervention Group = 14.40; for Internalizing problems mean rank of the TBI Intervention Group = 6.80, TBI Art Group = 12.13, TBI Control Group = 11.10, and ADHD Intervention Group = 10.41. [b]Exact level of significance not given, only asymptotic. CBCL = Child Behaviour Checklist. ADHD = Attention Deficit Hyperactive Disorder. The *r* value here is an estimate of effect size. *p = < .05.

Individual Comparisons: RCI Analyses

Table 10 presents a summary of the results for the RCI analyses of the cognitive measures for each of the four groups in the study. The majority of significant intrapersonal change took place in the ADHD Intervention Group, particularly on measures of the CPT-II as well as verbal memory. Of note, however, participant EN in the TBI Intervention Group and participant LE in the ADHD intervention Group (both 6-year-old males) showed significant improvements on the following measures of the CPT-II: Hit RT Block Change, Hit SE Block Change, Hit RT ISI Block Change and Hit SE ISI Change. These measures are indications of improved accuracy and consistency in reaction times to stimuli across the test. Although similar results were seen in the TBI control participant, 6-year-old male JB, during the administration of his post-test JB was extremely inattentive and required a significant amount of encouragement and motivation to focus and complete the test. His improvements should therefore be interpreted with caution, as both his pre- and post-test CPT-II reports found significant attentional deficits with 99.90% clinical confidence. ADHD Intervention participants CH (7-year-old female), JH (8-year-old male), and CS (8-year-old male) also showed significant improvements on these CPT-II measures compared to the TBI groups.

Table 11 presents a summary of the RCI analyses results of the behavioural measures for each group, showing the improvements in test scores for individual participants in each group. The majority of significant change on the BRIEF Parent report took place in the TBI Art Group. Consistent with these results, parents in this group also reported remarkable improvements in their children's behaviour and self-confidence upon completion of the art program. Significant improvements on the BRIEF Parent report were evident for two children in the TBI Intervention Group (one of which is participant EN), while the improvements noted in the ADHD Intervention participants were more widespread. The TBI Intervention Group as a whole showed more significant improvements on the internalizing and externalizing subscales of the Parent CBCL compared to the ADHD Intervention Group, but not relative to controls. Few significant changes were found in the VABS-II across groups.

Unfortunately, it was difficult to obtain teacher reports from participants in the TBI groups. Therefore, reliable comparisons cannot be made. However, it appears that teachers of participants in the ADHD Intervention Group observed the most significant improvements compared to children in the TBI Groups.

Table 10

RCI Analyses: Cognitive Domains for the Study Groups

	TBI Intervention Group (n = 5)					TBI Art Group (n = 4)				TBI Control Group (n = 5)					ADHD Intervention Group (n = 5)				
	AD	RW	DD	EN	AmP	AK	AnP	UM	TM	KM	BC	MM	LN	JB	CS	JH	CH	LE	LT
Age[a]	7	6	6	6	7	7	8	8	8	7	7	7	7	7	8	8	7	6	6
Sex[b]	M	F	M	M	M	M	F	F	M	M	F	M	M	M	M	M	F	M	M
Attention and concentration																			
Sky Search time-per-target	ΔΔ				ΔΔ														Δ
Sky Search attention score	Δ				Δ		Δ												Δ
Sky Search DT							ΔΔΔ	ΔΔ				ΔΔ		MD[3]					
Same World							ΔΔΔ	ΔΔΔ		ΔΔΔ	ΔΔΔ			MD[3]				Δ	
Opposite World	ΔΔ						ΔΔ	Δ		Δ	ΔΔΔ	Δ		MD[3]			Δ	Δ	
Omissions		MD[c]		ΔΔΔ		Δ		Δ	Δ		MD[c]	ΔΔΔ	ΔΔΔ	ΔΔΔ		ΔΔΔ			
Commissions		MD[c]					ΔΔΔ			Δ	MD[c]	Δ							Δ
Hit RT SE		MD[c]	Δ	ΔΔΔ			ΔΔΔ				MD[c]	ΔΔΔ	Δ			ΔΔΔ		ΔΔ	
Variability		MD[c]	ΔΔ	ΔΔΔ		ΔΔΔ		ΔΔΔ	ΔΔΔ	ΔΔΔ	MD[c]	ΔΔΔ		ΔΔΔ	ΔΔΔ	ΔΔΔ		ΔΔΔ	
Detectability	ΔΔΔ	MD[c]	ΔΔΔ				Δ			ΔΔΔ	MD[c]	ΔΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ				ΔΔΔ
Perseverations		MD[c]	Δ	ΔΔΔ	ΔΔΔ			ΔΔΔ		Δ	MD[c]	Δ		ΔΔΔ	ΔΔΔ	ΔΔΔ		Δ	ΔΔΔ
Hit RT Block Change	ΔΔΔ	MD[c]		ΔΔΔ					ΔΔΔ		MD[c]			ΔΔΔ	ΔΔΔ		ΔΔΔ	ΔΔΔ	
Hit SE Block Change		MD[c]		ΔΔΔ			ΔΔΔ	ΔΔΔ			MD[c]			ΔΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ	
Hit RT ISI Change		MD[c]		ΔΔΔ			ΔΔΔ			ΔΔΔ	MD[c]	ΔΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ	
Hit RT ISI Change		MD[c]		ΔΔΔ			ΔΔΔ			ΔΔΔ	MD[c]	ΔΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ	
Hit SE ISI Change		MD[c]		ΔΔΔ			ΔΔΔ	ΔΔΔ		ΔΔΔ	MD[c]	ΔΔΔ		ΔΔΔ	ΔΔΔ	ΔΔΔ		ΔΔΔ	ΔΔΔ
Confidence index		MD[c]		ΔΔΔ							MD[c]	ΔΔΔ				ΔΔΔ		ΔΔ	
Number forwards				Δ		Δ		Δ	Δ	Δ									Δ
Numbers backwards		MD[d]	MD[d]	Δ	Δ	MD[d]		ΔΔ				Δ	Δ	MD[d]				Δ	ΔΔΔ
Numbers total	Δ	MD[d]	MD[d]	Δ	Δ	MD[d]		ΔΔ	Δ		Δ			MD[d]				Δ	ΔΔΔ
INN Total CT				Δ		ΔΔΔ	Δ					ΔΔ				Δ		ΔΔ	
INN Combined SS						ΔΔΔ				Δ		ΔΔΔ							ΔΔΔ

INI Total CT			Δ			ΔΔΔ	ΔΔΔ		ΔΔΔ		ΔΔΔ	Δ	MD[d]	ΔΔΔ			Δ	ΔΔΔ
INI Combined SS			ΔΔΔ			Δ	ΔΔΔ				ΔΔ	ΔΔΔ	MD[d]		Δ		ΔΔ		ΔΔΔ
INN vs. INI Contrast SS			ΔΔΔ	Δ		MD[d]	ΔΔΔ	MD[d]	MD[d]	MD[d]	Δ	Δ	MD[d]	MD[d]	Δ		Δ		ΔΔΔ
Inhibition Total Errors	Δ	ΔΔΔ	ΔΔΔ			MD[d]	Δ	MD[d]	MD[d]	MD[d]	Δ	ΔΔΔ	MD[d]	MD[d]	MD[d]		Δ		ΔΔΔ
Memory and learning																			
DL Learning	Δ		ΔΔΔ			Δ				Δ		ΔΔΔ	ΔΔΔ		MD[d]		Δ		ΔΔΔ
DL Short Delay	Δ			Δ		Δ	Δ			Δ		ΔΔ	Δ		MD[d]				
DL Long Delay						Δ	ΔΔΔ					ΔΔΔ	Δ		MD[d]				ΔΔΔ
DL Total Score	ΔΔΔ		Δ			Δ	Δ			ΔΔ		ΔΔΔ	ΔΔ		MD[d]		Δ		
WL Learning			ΔΔΔ	ΔΔΔ		ΔΔΔ	Δ	ΔΔΔ	ΔΔ		ΔΔΔ	Δ	ΔΔ	Δ	MD[d]	ΔΔΔ	ΔΔΔ	ΔΔ	Δ
WL Delayed								Δ	ΔΔ			ΔΔ			MD[d]	ΔΔ	ΔΔΔ	ΔΔ	Δ
WL Delayed Recognition		Δ		ΔΔ	Δ			ΔΔ		ΔΔ		Δ			MD[d]	Δ		ΔΔΔ	ΔΔ

Note. [a]Ages presented in years. [b]M = Males, F = Females. MD[e] = Missing data because participant is too young for this test to be administered; MD[c] = Missing data because scores could not be generated due to atypical responses. MD[d] = Missing data because child could not complete the practice item of the test. Δ = a positive change of at least 1 standard deviation with a confidence interval of 68.26%; ΔΔ = a positive change of at least 1.96 standard deviations with a confidence interval of 95%; ΔΔΔ = a positive change of at least 2.58 standard deviations with a confidence interval of 99%. Test-retest reliability coefficients were only available for the following TEA-Ch subtests included in the test battery: Sky Search Time per Target, Sky Search Attention Score, Score, Sky Search DT, and Opposite Worlds. DT = Dual Task, RT = Reaction Time, SE = Standard Error, ISI = Inter-stimulus Interval, INN = Inhibition-Naming, CT = Completion Time, SS = Scaled Score, INI = Inhibition-Inhibition; DL = Dot Locations, WL = Word List.

Table 11

RCI Analyses: Behavioural Domains for the Study Groups

	TBI Intervention Group (*n* = 5)					TBI Art Group (*n* = 4)				TBI Control Group (*n* = 5)					ADHD Intervention Group (*n* = 5)				
	AD	RW	DD	EN	AmP	AK	AnP	UM	TM	KM	BC	MM	LN	JB	CS	JH	CH	LE	LT
Age[a]	7	6	6	6	7	7	8	8	8	7	7	7	7	7	8	8	7	6	6
Sex[b]	M	F	M	M	M	M	F	F	M	M	F	M	M	M	M	M	F	M	M
BRIEF parent report																			
Inhibition				ΔΔΔ	ΔΔΔ		ΔΔΔ		ΔΔΔ	ΔΔ		ΔΔΔ				Δ		ΔΔ	
Shift	Δ			ΔΔΔ	ΔΔΔ	ΔΔΔ		Δ	ΔΔΔ			ΔΔ				ΔΔΔ		ΔΔΔ	
Emotional control	Δ		ΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ			ΔΔΔ		Δ	ΔΔΔ		ΔΔΔ		ΔΔΔ			ΔΔ
Initiate				ΔΔ		ΔΔΔ	Δ		ΔΔΔ			ΔΔΔ		Δ		ΔΔ	ΔΔ		Δ
Working memory				Δ	ΔΔΔ	Δ			ΔΔΔ			ΔΔΔ					ΔΔΔ	ΔΔ	
Plan/organise				ΔΔΔ	ΔΔΔ	ΔΔΔ			ΔΔΔ			Δ		ΔΔΔ		ΔΔ	ΔΔΔ		
Org. of materials		Δ		ΔΔΔ		ΔΔΔ	Δ		ΔΔΔ	Δ		ΔΔΔ		Δ					ΔΔ
Monitor		Δ		ΔΔΔ	ΔΔ	ΔΔΔ			ΔΔΔ	Δ		ΔΔ		ΔΔΔ		Δ	ΔΔΔ		
BRI	Δ		Δ	ΔΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ		ΔΔΔ		Δ	ΔΔΔ		Δ		ΔΔΔ		ΔΔΔ	ΔΔ
MI				ΔΔΔ	ΔΔΔ	ΔΔΔ		ΔΔΔ	ΔΔΔ			ΔΔΔ		ΔΔΔ		Δ	ΔΔΔ		
GEC				ΔΔΔ	ΔΔΔ	ΔΔΔ	ΔΔΔ		ΔΔΔ			ΔΔΔ		ΔΔΔ		ΔΔΔ	ΔΔ	ΔΔ	ΔΔ
BRIEF teacher report																			
Inhibition						ΔΔΔ			MD			ΔΔ				Δ	ΔΔΔ		
Shift		MD		MD		Δ			MD				ΔΔΔ			ΔΔΔ	ΔΔΔ		
Emotional control		MD		MD									ΔΔΔ	Δ	ΔΔΔ	ΔΔΔ	ΔΔΔ		
Initiate		MD		MD		Δ			MD				Δ	Δ		ΔΔ	Δ		
Working memory		MD	Δ	MD		ΔΔΔ			MD	Δ			Δ	Δ		Δ	ΔΔΔ		
Plan/organise		MD		MD		ΔΔ			MD			Δ	ΔΔΔ			Δ	ΔΔΔ		
Org. of materials		MD		MD										Δ		Δ			
Monitor		MD	Δ	MD		ΔΔ			MD								ΔΔ		
BRI		MD		MD		ΔΔΔ			MD				ΔΔΔ			ΔΔΔ	ΔΔΔ	ΔΔΔ	
MI		MD		MD		ΔΔΔ			MD				ΔΔ	ΔΔΔ		ΔΔ	ΔΔΔ		
GEC		MD		MD		ΔΔΔ			MD				ΔΔΔ	Δ		ΔΔΔ	ΔΔΔ		

CBCL parent report																						
Internalizing behaviours			ΔΔΔ		ΔΔΔ		Δ		ΔΔΔ						ΔΔΔ		Δ					
Externalizing behaviours	ΔΔΔ		ΔΔΔ		ΔΔ				ΔΔ				ΔΔΔ	ΔΔΔ	ΔΔΔ		Δ		ΔΔΔ		ΔΔ	
CBCL teacher report																						
Internalizing behaviours									Δ			Δ	MD	ΔΔΔ			Δ		Δ			ΔΔΔ
Externalizing behaviours		MD			MD							ΔΔΔ	MD						Δ		ΔΔΔ	Δ
VABS-II																						
Communication					Δ		ΔΔΔ			ΔΔΔ			ΔΔΔ				ΔΔΔ		Δ		Δ	
Receptive							ΔΔ			Δ			Δ				Δ					
Expressive							Δ								Δ		Δ					
Written							Δ			Δ												
Daily Living Skills			ΔΔΔ				ΔΔ		Δ						ΔΔΔ		ΔΔΔ		ΔΔΔ	ΔΔΔ	Δ	
Personal							Δ		Δ						Δ		Δ					
Domestic															Δ							
Community			Δ														Δ					
Socialization			Δ						ΔΔ	Δ			ΔΔΔ		ΔΔΔ		ΔΔΔ		Δ			Δ
Interpersonal relationships									Δ				Δ		Δ							
Play and leisure time													Δ		Δ		ΔΔΔ					
Coping Skills													Δ				Δ					
Adaptive behaviour composite			ΔΔΔ		Δ		ΔΔΔ		ΔΔ	ΔΔΔ			ΔΔΔ		ΔΔΔ		ΔΔΔ		ΔΔΔ	ΔΔΔ	ΔΔΔ	

Note. Δ = a positive change of at least 1 standard deviation with a confidence interval of 68.26%; ΔΔ = a positive change of at least 1.96 standard deviations with a confidence interval of 95%; ΔΔΔ = a positive change of at least 2.58 standard deviations with a confidence interval of 99%. BRIEF = Behaviour Rating Inventory of Executive Function, BRI = Behaviour recognition index, Org. = Organization, MI = Metacognition Index, GEC = Global Executive Composite. MD = Missing data due to teachers not consenting to participate in the study, CBCL = Child Behaviour Checklist, VABS-II = Vinelands Adaptive Behaviour Scale – Second Edition.

Discussion

Cognitive rehabilitation for children post-TBI is a young field, and the evidence to support its efficacy in international and South African literature has been inconclusive. There has also been a lack of research into rehabilitating children in LAMICs generally, where incidence rates of injury tend to be higher, and access to and availability of rehabilitation services, are limited. Children in countries such as South Africa, are therefore most vulnerable to TBIs and their resulting consequences, and are likely to return to school post-injury with severe cognitive sequelae that are not being addressed.

I chose to implement an attention-training program for three primary reasons. First, attention is one of the most common deficits in children post-TBI. Second, attention is the foundation of learning, and even minor attentional difficulties have far-reaching academic, social and behavioural sequelae. Third, the potential for efficacy for this type of cognitive rehabilitation has been supported in the literature and there has been an increase in publications on the topic of attention remediation particularly over the last five years. The 'Pay Attention!' program was chosen specifically as it is easily accessible in South Africa. The intervention is not a computerized measure, which is appropriate for our setting because the majority of pTBIs occur in children who come from low SES backgrounds, and who therefore do not have access to computers and are therefore not computer literate. Hence, a paper and pencil intervention might be more affordable and sustainable should it prove to be efficacious. The 'Pay Attention!' program has also been shown to be efficacious in improving attention in two clinical samples thus far (i.e. ADHD and dyslexia). An unpublished South African pilot study also provided some evidence for its potential efficacy and feasibility for children with TBI.

The primary research question in this study was to investigate the efficacy of the 'Pay Attention!' program for children who have sustained a TBI in South Africa. In doing so I also aimed to compare performance and outcomes in the program between children diagnosed with ADHD and children who have sustained a TBI, and also to examine the feasibility of implementing a program of this nature in South Africa. I will now discuss each aim individually with the results of the study.

Aim 1: Efficacy of 'Pay Attention' with a pTBI Sample

I aimed to examine the efficacy of the 'Pay Attention!' intervention between-groups and within-groups on both neuropsychological tests and real world measures (i.e. parent and teacher rating scales). I also collected data of children's individual performances in each intervention session, in order to determine what exercises to administer in the following

session, and to monitor their progress. My hypothesis was that the 'Pay Attention' rehabilitation program would improve attention in South African children who have sustained TBI. This primary hypothesis was rejected, as significant results from the neuropsychological and behavioural tests were largely not found post-intervention.

At pre-test, no significant differences were found between the three TBI groups on the cognitive or behavioural measures. No significant between-group or within-group differences were found on any of the neuropsychological tests of attention and memory post-intervention. Similarly, the RCI analyses did not show that individuals in the TBI Intervention Group made significant improvement post-intervention in the neuropsychological tests, relative to controls. Only one 6-year-old child showed some improvements on measures of the CPT-II. These non-significant results are inconsistent with the previous published studies conducted on 'Pay Attention!' (Chenault et al., 2006; Kerns et al., 1999; Penkman, 2004; Tamm et al., 2010, 2013). The non-significant results are also inconsistent with Schrieff's (2013) unpublished pilot study, as no improvements in the Inhibition subtests of the NEPSY-II were found.

In terms of behavioural measures, parents of children in the TBI Intervention Group (like parents of children in the ADHD Intervention Group) reported improved within-group Attention and ADHD behaviours as measured by the CBCL. Parents of children in the TBI Intervention Group also reported improvements on Personal and Domestic adaptive behaviours as measured by the VABS-II. These positive parent reports could be consistent with the 'Pay Attention!' literature, and indeed indicative of the efficacy of the 'Pay Attention!' intervention. However, in the studies where parents report improvements in their children, the children also perform better in the cognitive measures at post-test (Penkman, 2004; Tamm et al., 2010, 2013), which was not the case in the current study. The positive reports could also be a result of information bias, in that the parents knew that their children were undergoing attention training and therefore expected them to improve. Furthermore, the reports could also be attributed to social desirability, in that the parents reported improvements in their children to either appease the researcher, or promote their child (Stangor, 2011).

The RCI analyses showed that parents of children in the TBI Intervention Group and TBI Art Group reported that their children had made significant improvements in their executive functioning at home and school, relative to controls, as indicated by high scores on the BRIEF. Children in both of these groups received one-on-one attention twice a week for

12 weeks, and so these results could be indicative of a positive change resulting from increased social interaction and/or cognitive stimulation.

One further significant result at post-test was that scores on the Anxious/Depressed subscale of the Parent CBCL were significantly higher in the ADHD group compared to other groups, indicating that the children diagnosed with ADHD were more anxious or depressed post-intervention. Although children with TBI, particularly those who come from low SES backgrounds, are likely to have symptoms of depression post-injury (Kirkwood & Yeates, 2010), comorbid anxiety and/or depression are quite common in children diagnosed with ADHD, and the literature frequently reports high parent ratings on the CBCL subscale for this clinical sample (Biederman et al., 1993, 2012; Biederman, Faraone, Mick, Moor, & Lelon, 1996; Biederman, Monuteaux, Kendrick, Klein, & Faraone, 2005; Connor et al., 2003). It is therefore highly unlikely that this finding is directly related to the intervention employed in this study.

In terms of the performance of the TBI Intervention Group on the 'Pay Attention!' intervention, most children progressed through the activities slowly. The children struggled to improve both their time and accuracy over three consecutive sessions, and it could take a number of weeks before I could move on to a more difficult task. The children would often exclaim that they were bored with the program materials and activities and request that we play different games.

There are a number of plausible explanations to explain the largely non-significant results found in this study. First, the TBI groups were not evenly matched on a number of injury and demographic criteria. For example, the control group's injuries were sustained more recently compared to the other two groups. However, it is unlikely that improvements in the control group's performance may have been due to spontaneous recovery as all children in this group had sustained their TBIs at least two years before, and spontaneous recovery post-injury tends to take place in the first one-to-two years post injury (Anderson et al., 2001b; Ginstfeldt & Emanuelson, 2010; Yeates et al., 2002). Nevertheless, this significant difference in time since injury calls into question the ideal time for cognitive rehabilitation intervention.

Perhaps there would have been an improvement in the TBI Intervention Group had I introduced the rehabilitation program earlier in recovery. Rehabilitation needs to be timed so that it minimizes the period of disability and maximizes on the functional reorganisation potential of the brain, in order to enable recovery (Beaulieu, 2002). Many researchers have questioned the optimal timing of cognitive rehabilitation implementation, but conclusive

answers have not been reached (Butler & Copeland, 2002; Cicerone et al., 2011; Gordon et al., 2006; van't Hooft, 2010). For example, Bergsneider and colleagues (2001) used quantitative PET scans to examine metabolic recovery mechanisms post-TBI. The researchers found that metabolic recovery takes places several weeks post-injury, and queried whether this period could either be a positive recovery window for cognitive rehabilitation, or if cognitive stimulation would further damage neural connections.

A significant difference was also found between groups on race and home language distribution. The children listed on RXH's database were predominantly Black African and isiXhosa speaking. This finding was unsurprising as 80,2% of the population in South Africa is Black African, and English is the least commonly spoken language in South Africa (Statistics South Africa, 2014; South African Census, 2011)[7]. As has been discussed, a large percentage of the Black African community tends to be of low SES due to South Africa's history of apartheid and inequality. The majority of pTBIs occur in this low SES context as children play in the roads unsupervised, or travel in taxis that are prone to accidents (Schrieff et al., 2013).

Although the majority of South Africans are not English-speaking, the 'Pay Attention!' program is only available in English and has not been translated into any other languages. It is not yet feasible to translate the intervention materials given the preliminary stage of this research and the fact that the materials include audio CDs. Therefore, I needed to place the English-speaking children, all of whom were not Black African, into the Intervention Group.

In relation to this, three of these English-speaking children in the TBI Intervention Group were Muslim and participated in the month-long religious fasting period of Ramadaan. They each therefore attended 8 intervention sessions (approximately 30%) where they had not eaten for a number of hours, and were noticeably more tired and inattentive. Studies have shown that fasting negatively affects children's and young adult's cognition (Benton, 2008, 2010; Tian et al., 2011).

On such a small sample size, these significant injury and demographic differences may have contributed to not finding efficacious intervention results. That being said, a strength of the study is that all children were within a contained age range and matched on sex, and the mechanism of injury was also well controlled. The majority of studies in this field have investigated children with ABI, and when positive results are found it is not clear

[7] 8.8% of the population is Coloured, 8,4% is White, and 2,5% is Asian/Indian.

who, in terms of etiology, has benefitted the most and why (e.g. the studies outlined in Table 1). All children with TBI in this study had sustained their injury through involvement of an MVA – either as a passenger or pedestrian.

A second reason for the lack of significant results post-intervention might be due to the frequency and duration of the intervention. Although this study aligned itself with the current recommendations from 'Pay Attention!' researchers, and extended the implementation from 10 weeks to 12 weeks as suggested by Schrieff (2013), more substantial effects may be observed if the program was implemented for longer, or with increased intensity. A strength of the study, however, is that the children with TBI attended at least 80% of the intervention sessions.

A third reason for the lack of significant results could be due to the structure of the 'Pay Attention!' program. The exercises are very repetitive (as they should be in cognitive retraining) and there are a limited amount of materials used. The exercises quickly became mundane for the children, and they required a copious amount of encouragement and motivation to try to improve their performance.

In addition, most of the children did not improve both their time and accuracy in tasks over three consecutive sessions (as is required to progress to different tasks), because their attention seemed to fluctuate within minutes or between sessions. This pattern is consistent with general pTBI characteristics where children have great variability in performance across tasks and over time (Sohlberg et al., 2014). Children in the study would therefore, for example, make progress over two sessions and then perform poorly in the third session. At the end of 24 sessions, some children were still trying to master exercises that were administered in the earlier sessions. The combination of children feeling bored with the program, with their attention constantly fluctuating, could have lead to a lack of improved attention post-intervention.

In relation to the effect of fluctuating attention on performance, a fourth explanation for the lack of significant results could be related to the fact that children have great variability in outcome post-TBI (Power et al., 2007; Sohlberg et al., 2014; Taylor, 2004; Yeates et al., 2002; 2004). For example, some children who had been admitted to RXH with a severe GCS had seemingly less severe attention deficits than children who had sustained more moderate injuries. Outcome post-TBI is of course related to a host of predictors (Catroppa & Anderson, 2007; Catroppa et al., 2011; Giza et al., 2007; Greve & Zink, 2009; Javouhey et al., 2011; Slomine et al., 2002; Yeates et al., 2002) like premorbid functioning and GCS scores (on which severity was based). Any one or any combination of these

outcome factors are likely to influence a child's attentional difficulties post-injury, as well as a child's capacity for recovery (Taylor, 2004). However, in line with the dose-response relationship of injury severity and cognitive impairment, the children who had the more severe injuries progressed slower through the program compared to the children with more moderate injuries, and were more frustrated with the program. It is therefore possible that the 'Pay Attention!' program might be more suitable for children with less severe injuries.

Considering the obstacles I experienced during recruitment, it would be very difficult to control for all of these factors that affect the variability in attention outcome, as there are many such factors to consider, and the sample pool of moderate-to-severe TBI is relatively small compared to children who sustain milder injuries (Nell & Brown, 1991; Tagliaferri et al., 2006). That being said, this study did include two TBI control groups in an attempt to control for some degree of this variability. The TBI control groups are a strength of the study, and built upon Schrieff's (2013) recommendations. However, as many researchers in the field advocate, it is possible that interventions in this field should not be applied with a blanket approach to all children, and should be more tailored to their individual needs (Anderson & Catroppa, 2006; Gordon et al., 2006; Laatsch et al., 2007; Limond & Leeke, 2005; Ross et al., 2011; Tsaousides & Gordon, 2009; van't Hooft et al., 2003; Wilson et al., 2013; Ylvisaker et al., 2005).

Furthermore, the intervention under investigation is based on Sohlberg and Mateer's (2001) clinical model of attention, which divides attention into 5 hierarchical subcomponents. Several long-standing theories have purported that attention is integrally linked to other functions such as working memory and executive functioning (Baddeley, 1986, 2010; Norman & Shallice, 1986; Posner & Petersen, 1990). In support of this concept, researchers have also found that children with attention deficits have working memory and executive function difficulties, with a dose-response relationship (e.g. Friedman et al., 2007; Gathercole et al., 2008; Scope, Empson, & McHale, 2010). Therefore, perhaps the process specific training approach is not as effective independently as compared to it being incorporated in a more comprehensive and holistic approach to rehabilitation, considering the close ties attention has with other cognitive domains.

Another possibility in terms of the results of the study is that attention did improve generally but did not specifically reflect on the neuropsychological testing. The tests chosen were based on tests that are used in the international rehabilitation literature, as well as in South African clinical practice. In addition, I attempted to use real world measures by including behavioural measures in the study. I chose the VABS-II in particular as it is

considered to be an ecologically valid outcome measure in cognitive rehabilitation studies (Galbiati et al., 2009; Gioia & Isquith, 2004; Limond & Leeke, 2005), and minor improvements were seen in the current study on some of these behavioural measures. Researchers in the field frequently query if their measures are appropriate, sensitive enough to the construct being measured, and void of test-retest effects (Galbiati et al., 2009; Rohling et al., 2009; Sohlberg et al., 2014). As has been discussed, the purpose of rehabilitation is not to improve performance on test scores, but rather to ensure improvements occur in everyday life to allow an individual to become independent (Wilson et al., 2013). For example, Wilson (1997) and Wilson et al. (2013) discuss a case where a densely amnestic patient has shown no improvements on psychometric testing during his rehabilitation process, but, through using compensatory aids and strategies, is living independently and is self-employed. Therefore, it is possible that we are not measuring the efficacy of interventions as optimally as we should.

Many researchers are currently strongly encouraging the use of neuroimaging to assess the efficacy of rehabilitation programs, as scans allow researchers to detect and understand the mechanisms responsible for individual recovery after injury (Cicerone, Levin, Malec, Stuss, & Whyte, 2006; Erickson et al., 2007; Fox & Greicius, 2010; Hunter, Wilde, Tong, & Holshouser, 2012; Kesler, Lacayo, & Jo, 2011; Kou et al., 2010; Kramer et al., 2008; Ricker, Hillary & DeLuca, 2001; Strangman et al., 2005). For example, Kim et al. (2009) conducted an fMRI study to examine the plasticity of the neural attentional network after attention training in adults with moderate TBI. Pre-intervention, the 10 TBI participants had increased activation in the frontal and temporoparietal lobes, and decreased activation in the anterior cingulate gyrus, supplementary motor area, and temporo-occipital regions compared to the healthy control group. Although the frontal lobes are involved in the attentional network, the activation pattern found in the study indicates that participants were using compensatory or additional frontal mechanisms to attend to information, as opposed to using structures directly responsible for attending. However, after completing attention training using ComCog rehabilitation software, the TBI participants showed decreased activation in the frontal lobes, and increased activation in the anterior cingulate cortices and precuneus. The changes in the attentional network post-intervention support the improved performance on attention tasks that was measured, leading the researchers to conclude that plasticity in the TBI patients' attentional network was observed. This type of transfer of function would not be picked up on neuropsychological tests, but could allow researchers the opportunity to understand the mechanisms behind recovery. However, no study to date has used this technology to monitor the effects of attention training, or any cognitive

rehabilitation, in a sample of children with TBI.

Of course, I also need to acknowledge the obvious possibility that the intervention was not efficacious for this TBI sample. However, given the identified methodological limitations, it is difficult to conclusively state this outcome.

Aim 2: Efficacy of 'Pay Attention' Between Two Clinical Groups

My second aim was to investigate whether the children who sustained a TBI would improve their attention through 'Pay Attention!' in the same way as children who had been diagnosed with ADHD. The two clinical samples had different performance patterns in the neuropsychological tests, which was predominantly seen by the RCI analyses. In addition, it appears that secondary gains were made in verbal memory in the ADHD Intervention group, but not in the TBI Intervention Group.

At pre-test, no significant differences were found between clinical samples on the test composites, and only one significant difference was found on the behavioural measures. Parents of children in the ADHD group had significantly lower ratings of Somatic Complaints on the CBCL, compared to parents of children in the three TBI groups. One reason that the ADHD sample had lower ratings of Somatic Complaints could be that elevated CBCL ratings of Somatic Complaints in children diagnosed with ADHD are predominantly found in females, and the ADHD sample in this study consisted predominantly of males (Graetz, Sawyer & Baghurst, 2005). Alternatively, as mentioned, children with TBI are likely to have high levels of premorbid Somatic Complaints (Olsson et al., 2008). Another explanation for the differences found in Somatic Complaints could be due to SES: individuals who come from lower SES backgrounds (i.e. the TBI groups) are more likely to have more Somatic Complaints compared to individuals from higher SES backgrounds (i.e. the ADHD group; Huurre, Rahkonen, Komulainen, & Aro, 2005).

No significant within-group or between-group differences were found on the neuropsychological test composites. There are a number of reasons that could account for these results. To begin within, the TBI and ADHD groups were not matched on SES, home language, race, age, and IQ. In terms of SES, on the one hand, the health professionals that I approached as part of my recruitment strategies reported that they rarely see pTBIs in higher demographic samples as parents have cars with safety features, and supervise their children after school. This outcome is consistent with the literature, in which the incidence of MVAs and other mechanisms of trauma are considerably higher in lower SES levels of society (Abdur-Rahman, van As, & Rode, 2012; Ataguba, Akazili, & McIntyre, 2011; Brattström, Eriksson, Larsson, & Oldner, 2014; Dhaffala et al., 2013; Elias & Shiftan, 2014; Sehat,

Naieni, Asadi-Lari, Foroushani, & Malek-Afzali, 2012). In all but one case, the children in my study who had been involved in an MVA pedestrian sustained their injuries because they were playing in the street unsupervised. Similarly, in all but one case, the children in my study who sustained a TBI as a result of an MVA passenger had been involved in taxi accidents. These types of activities rarely occur in higher SES samples. This finding is in keeping with Schrieff et al.'s (2013) study, where the majority of children who sustained severe TBIs in that study were from low SES backgrounds, and were involved in a MVA.

The differences found in the current sample in home language and race are directly linked to SES. As has been mentioned, white, English speakers are the minority of the population and are generally from a higher SES, whereas Black isiXhosa speaking and Coloured[8] Afrikaans speaking populations form the majority of the population are generally from a lower SES (South African Census, 2011; Statistics South Africa, 2014).

On the other hand, it was also very difficult to find children from a lower SES who had been formally diagnosed with ADHD, as disadvantaged schools in South Africa tend to be under resourced and diagnoses of a 'pure' ADHD are rarely recognised. ADHD symptoms are also only usually recognised when children attend school for the first time and are required to sit still and attend in a structured environment, which is why this ADHD sample is slightly older. The socioeconomic disparities between the two clinical samples in the study also account for the difference in IQ, as children from higher SES backgrounds tend to perform better in IQ tests compared to children from disadvantaged backgrounds (Bradley & Corwyn, 2002; Hackman & Farah, 2009; Turkheimer, Haley, Waldron, d'Onofrio, & Gottesman, 2003). Children from lower SES backgrounds tend to have poorer cognition compared to children from higher SES demographics due to factors such as pre- and/or perinatal complications during pregnancy; inconsistent, harsh or distant parenting styles; unstable home/family environments; and limited access to high quality education (Bradley & Corwyn, 2002; Kishiyama, Boyce, Jimenez, Perry, & Knight, 2008; McLoyd, 1998; Sarsour et al., 2011).

Although the results from the cognitive composites were largely non-significant, the two clinical samples had different performance patterns in the individual cognitive and behavioural tests. For example, in terms of behavioural reports, as has been discussed, within-group analyses showed that parents in both intervention groups reported improved attention and ADHD behaviours. Furthermore, the RCI showed that the parents and teachers

[8] A racial category used in South Africa for persons of mixed ancestry.

of children in the ADHD Intervention Group noted significantly more improvements on subscales of the BRIEF post-intervention, compared to behavioural reports of the TBI Intervention Group sample. In addition, parents of children in the TBI Intervention Group noted improvements in the CBCL compared to the ADHD Intervention Group.

Moreover, because the ADHD sample comes from a higher SES background with subsequent access to more resources, it is not surprising that they generally performed better in neuropsychological testing compared to the TBI group (i.e. as evidenced by the means and standard deviations across measures), and that they progressed through the 'Pay Attention!' program at a faster rate. Like children in the TBI Intervention Group, the children with ADHD also complained that they were bored, however they were constantly exposed to more challenging tasks.

The ADHD Group also showed significantly more individual improvements on the CPT-II and measures of verbal memory compared to the TBI Intervention Group. The improvements in verbal memory in the ADHD Intervention Group were also evident on between-group post-test analyses conducted on individual subtests, and could be due to the efficacy of the 'Pay Attention!' intervention. Attention is not a solely modular system but rather it interacts with other domains, such as memory and executive function. Attention and memory are closely linked, as one needs to pay attention in order to remember, which underpins all learning (Anderson et al., 2001b; Chenault et al., 2006). The exercises in the 'Pay Attention!' program are repetitive and children would often know what was required of them because they recalled completing the exercise the previous session. It is therefore possible that verbal memory was incidentally being trained. Programs such as the AMAT-c, which is also based on Sohlberg and Mateer's model of attention (1987), train both attention and memory, possibly for these reasons, and studies tend to find positive outcomes in both domains (e.g. van't Hooft et al., 2003, 2005, 2007). However, previous studies conducted on 'Pay Attention!' have not explicitly tested for improvements in verbal or visual memory, like other cognitive rehabilitation programs have done (e.g. Brett & Laatsch, 1998; Sjö et al., 2010, van't Hooft et al., 2003, 2005, 2007), and so it is unclear to what extent memory is typically improved in children who undergo this intervention. Future researchers could perhaps include additional memory tests into their battery to further explore this study's potential finding.

It is important to note that the improved performance in the ADHD Intervention Group occurred despite the poor average session attendance in the group. It is possible that more significant results would have been evident had they attended more sessions. Tamm et

al. (2013) found significant results in children diagnosed with ADHD (not specifically on the CPT-II, but on other neuropsychological tests of attention), where the attendance rate was more than 80%. Three of the children attended sessions at UCT during the week as their parents or caregivers had their own transportation and were self-employed or worked flexible hours. These children were able to attend 79-80% of sessions. The intervention was implemented for two children at their school. Each child was absent from school on 4 and 6 occasions respectively, and these sessions could not be made up as parents did not have easy access to transport their children to UCT, and could not take time off work. These parents could also not transport their children to UCT during the three weeks of school holidays for the same reasons, and therefore each child missed a further 6 sessions. The Clinical Psychology Masters student who assisted me with this group was unable to travel to these two children's homes as the areas in which they live are well known for high incidences of crime, violence and gangsterism. Even though two children only attended 50-60% of sessions, they still showed marked improvements on the CPT-II, which indicates that this program may be more appropriate for an ADHD sample compared to a TBI sample.

One reason that the clinical samples performed differently on the actual intervention as well as during testing (as seen primarily on the RCI), could be because the 'Pay Attention' program may target a developmental attention deficit (i.e. P-ADHD), which is of a different nature compared to an acquired attention deficit post TBI (i.e. S-ADHD). There are a number of studies that support different neuropsychological profiles for each clinical sample. For example, using fMRI, Kramer et al. (2008) found an over-activation in the frontal and parietal brain regions in children with moderate-to-severe TBI during a sustained attention task. The patterns of over-activation are in contrast with the profiles of children diagnosed with P-ADHD, where, an under-activation of the attention network is documented. The researchers concluded that neural changes in the frontal and parietal areas occur post-pTBI, thereby affecting sustained attention in the long-term. Sinopoli and colleagues (2011) found that children with acquired ADHD post-TBI had poor cancellation inhibition during tasks of inhibitory control, compared to children with developmental ADHD. In addition, the authors found that in these inhibitory control tasks, although reward facilitated cancellation and restraint inhibition (i.e. the percentage of responses inhibited during the restraint version of a stop signal task) in children with P-ADHD and S-ADHD, the P-ADHD group had a persistently poor performance, and participants in the S-ADHD group had a selective difficulty with cancellation inhibition. By demonstrating that the two clinical groups have distinct performance patterns on the same inhibitory tasks, Sinopoli and Dennis (2012) infer

that the underlying mechanisms are different in P-ADHD and S-ADHD, although the specific details are yet to be determined. Similarly, Ornstein and colleagues (2013) reported that inhibition on a stop signal response inhibition task is impaired in both children with P-ADHD and S-ADHD, although children with P-ADHD tend to perform slightly worse on the task. However, the authors speculate that the performance of the children with S-ADHD may be directly related to TBI severity. Once again, the authors note that the underlying mechanisms between these two clinical samples are yet to be determined. They postulate that the mechanism is likely to be related to prefrontal dysfunction, or to a more distributed neural network that are dependent on the frontal lobes. There have been no other studies to date that have directly compared the TBI versus ADHD samples, although researchers have acknowledged that the mechanism behind attentional deficits in P-ADHD and S-ADHD needs to be investigated in more depth (Levin et al., 2007; Sinopoli et al., 2011).

Aim 3: Feasibility and Applicability of the Intervention

My third aim was to evaluate whether it would be feasible to implement a cognitive rehabilitation intervention in a LAMIC setting, where there is a lack of infrastructure and services of this nature.

UCT and RXH were very accommodating and pTBI participants were easily able to access both venues. However, parents of all four children in the TBI Art Group informed us that the participation fee was not enough to cover basic transport costs, and required double the fee we were offering. These four parents all relied on public transportation and lived 30-60 minutes away from RXH. Two parents from the TBI Intervention Group required an extra smaller amount of money due to public transportation costs, while the other three parents in this group did not voice concerns over the participation fees as they had their own vehicles. Therefore, when implementing rehabilitation therapies in South Africa, researchers must be aware of transportation costs and accommodate participants either by ensuring they have enough funds to travel to the research setting, or by implementing the intervention in a more convenient location.

The attendance in the TBI Intervention Group was also higher compared to the TBI Art Group, and children in the former group still attended sessions during school holidays while children in the latter group did not. Parents in the TBI Intervention Group were also more willing than the TBI Art Group to make up missed sessions. Parents would often arrange for a grandparent or other relative to bring the child in for a session if the parent was unavailable, or would bring their other children with to the hospital if they could not find a

babysitter. It is therefore possible that committed parents, even with limited access to resources, can sustain their children's attendance for cognitive rehabilitation interventions.

The actual 'Pay Intention!' intervention was also simple to implement as the materials are readily transportable and easy to use. Although I thoroughly enjoyed the opportunity to facilitate this program, I found that administering it frequently and intensely to five children twice a week to be challenging. Having more facilitators per child, or having one facilitator with two children in a session, could decrease the intensity of administration. However, training attention does require one-on-one administration and so perhaps having a dedicated person per family, be it a parent/caregiver or teacher, might create a better and more sustainable system.

Limitations and Suggestions for Future Research

The first limitation is the small sample size, which is in keeping with previous cognitive rehabilitation studies for pTBI (e.g. Thomas-Stonell et al., 1994; Thomson, 1995; Sohlberg et al., 2014). The studies that have bigger sample sizes include children who have sustained ABIs, or who have mixed etiologies for their injuries (e.g. van't Hooft et al., 2005; 2007). Unfortunately due to the difficulties in recruitment, as well as lack of resources, it was difficult to include a bigger sample. It is possible that this is a major reason for the lack of significant results, as the effect sizes in the study were predominantly in the small-to-medium range. Although we made every effort to encourage participants to attend sessions regularly, unfortunately one participant withdrew from the study and the groups were uneven in number. Future researchers should recruit more research volunteers to implement the program so that more children could be recruited into the study, and perhaps find locations even closer to the children's homes or schools to facilitate ease of access to the intervention sessions.

The second limitation is that the groups were unevenly matched, which makes it difficult to understand which children (in terms of their demographic and injury profile) would benefit the most from this intervention. Future studies should perhaps consider translating this program into isiXhosa in order to be accessible to more South African children. However, this is the first study of its kind that used children with TBI who had all sustained their injuries via the same mechanism. The age range was also narrowed down, so that we could thoroughly study a specific group of children. I also included two control groups to control for time spent with children (TBI Art Group) as well as spontaneous recovery over time and test practice effects (TBI Control Group). Future researchers should

aim to control as many of these demographic and injury related factors as possible, and ensure control groups are included in the research design to exclude extraneous variables.

A third limitation is that the ADHD group attendance was poor for two children. The improvements noted on the RCI indicate that this group could have had significant improvements had they attended more sessions. Future researchers will need to take into consideration their participants' psychosocial circumstances i.e. their residential and school location, access to transport, and availability of a parent or caregiver to bring them to sessions. The facilitator would also need to have sufficient time to reschedule missed sessions. It might also be advisable for the facilitator to arrange to see children who live in the same area on the same day, in order to decrease travel time and make the facilitator more available to make up missed sessions. In terms of school holidays, interventions should either be implemented at the beginning of term, schedule a break that coincides with the school term, or make transport arrangement with the parents before intervention implementation.

A fourth limitation might be that I relied only on neuropsychological testing and parent and teacher information as outcome measures. I used parental and teacher behavioural measures, as well as the VABS-II in the hope of accessing some real world descriptions of behaviour (Sparrow et al., 1984). The VABS-II is considered to be an ecologically valid outcome measure in cognitive rehabilitation studies (Galbiati et al., 2009; Gioia & Isquith, 2004; Limond & Leeke, 2005). Although these tests most certainly have value, it might have been useful to also include an additional, real world task specific to each child (e.g., a specific attention-related task that each child struggled with in the home/school environment), or some kind of neuroimaging to examine the efficacy of the intervention in more detail and with greater ecological validity.

A fifth limitation is that the test-retest coefficients were not available for all of the subtests used, particularly in the TEA-Ch. The RCI could therefore not be calculated for these measures.

A sixth limitation is that for some statistical analyses, SPSS could only generate an asymptotic *p*-value and not an exact *p*-value. Asymptotic values are considered to be accurate for calculations with large samples, and in some cases with a small sample size these values may lead to some Type I errors.

A seventh limitation is that the study ran through the school holidays and the Ramadan religious holidays. Attendance in the TBI Art Group rapidly decreased, and the research assistants reported that children were more inattentive during these three weeks. In the TBI Intervention Group, children's attention significantly dropped during Ramadan, and

it was difficult to keep them focused. As I have already mentioned in relation to ADHD Group attendance, future researchers should aim to implement the intervention at the beginning of the year, and perhaps take the school holidays as a break, or make arrangements with parents in advance.

A final limitation is the possibility of having children with undiagnosed disorders in the sample. Children were excluded from the study who had been diagnosed with P-ADHD prior to their TBI, however it is possible that some children had suspected yet undiagnosed P-ADHD. As has been discussed, children who sustain TBIs are likely to have premorbid attention difficulties, or even P-ADHD, and their inattention is likely to worsen post-injury (Backeljauw & Kurowski, 2014; Gerring et al., 1998; Slomine et al., 2005; Yeates et al., 2005).

Of note, is that children in the TBI Art Group made individual improvements in some of the neuropsychological tests of attention, and that both the TBI Intervention Group and the TBI Art Group had improved scores on the Parent BRIEF at post-test. The purpose of including the TBI Art Group in the study was to control for effects of time spent with participants, as it was theorised that just spending time with children who do not have access to additional stimulation may improve their cognition. It appears that children did benefit from regular one-on-one interaction with an adult, which illustrates that time spent engaging with participants, particularly those from low SES homes, may have a confounding effect on intervention outcomes and must be acknowledged.

Following on, it is also important to note that the TBI Art Group ran successfully, and parents of children began to arrive for the session earlier each week and created an informal support group. These parents reported that they had found common ground with each other and were able to connect easily with those who had shared similar experiences. Parents in this group noted improvements in their children in terms of increased independence, self-confidence and esteem, and decreased bullying and violent behaviours. It is also therefore important to note that there is also a place in South African post-pTBI rehabilitation services for emotive-based therapies for both children and their parents, and patients would benefit from counselling and support, which they currently have minimal access to. A phenomenological study conducted on four mothers of children with TBI in Cape Town found that mothers feel a personal burden of care, as the majority of their day is consumed by caring for their child. These mothers stressed a need for counselling and support to help them better cope with their stressors and prevent a decline in their well-being (du Toit, Coetzee, & Beeton, 2013).

The inclusion of this Art control group is a strength of the study. Another strength is that the neuropsychology interns who administered the tests were blind as to the participant's group assignment. The Clinical Psychology Masters student did not administer any neuropsychological tests pre- or post-assessment. I only administered the pre-tests for the ADHD group because I knew I would not be implementing the intervention with them. These protocols were implemented to reduce bias in testing, particularly post-intervention.

The methodological and theoretical limitations outlined in this study highlight the need for this country to have research and rehabilitation centres that are specialised in pediatrics, so that we can continue to develop and refine research designs and techniques in the field. Children should be referred to a centre and placed on a database, so that researchers and volunteers can easily find children who need multidisciplinary rehabilitation efforts, and children can begin assisting researchers in developing programs that suit their needs. Cognitive rehabilitation for children, particularly in a LAMIC, requires cooperation and commitment between children, their parents, researchers and clinicians, as well as an appropriate environment in which to maximize results.

Summary and Conclusion

This study concludes that interventions such as 'Pay Attention!' are feasible to implement in South Africa, and that it can run with limited infrastructure and access to resources. Although the 'Pay Attention' intervention has potential to be efficacious in an ADHD sample, currently it does not show the same promise for a pTBI sample. However, given the limitations identified in this study, further investigation is needed. This finding is however consistent with others in the current international literature, in which there is an awareness of the methodological difficulties in this field and consequently, the inconclusive results of intervention studies. An obvious ethical question is raised, as to why this research continues in the face of results that indicate limited efficacy. Why go to the effort of implementing intensive one-on-one studies with non-significant results?

One possible answer is that cognitive rehabilitation services are needed in pTBI samples and *can* be implemented even in disadvantaged communities; however, further research is required as to the types of interventions that are most appropriate. In addition, considering the economic burden of pTBI, even if one type of rehabilitation intervention is only successful for a specific profile of patients, it should still be implemented.

Perhaps we cannot borrow interventions from other samples, and need to better understand the mechanisms behind acquired vs. neurodevelopmental attentional deficits in order to develop a more holistic and tailored rehabilitation program that account for clinical

TBI features associated with pTBI such as fluctuating attention and variability in outcome. A new approach may need to be more dynamic and interactive in order to hold children's attention.

This thesis therefore serves to advocate the need for future research in cognitive rehabilitation for children post-TBI. The injuries sustained by these children were accidental, and the cognitive sequelae are often silent. Researchers have a vital role in children's recovery, and have only just begun to investigate ways to assist the children affected. This thesis posits that there is ample potential for cognitive rehabilitation post pTBI, and ongoing efforts will serve to further develop the field.

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APPENDIX A

Ethical Approval from the University of Cape Town Faculty of Health Sciences

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E52-24 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6338 • **Facsimile** [021] 406 6411
Email: shuretta.thomas@uct.ac.za
Website: www.health.uct.ac.za/research/humanethics/forms

20 December 2013

HREC REF: 597/2013

Dr L Schrieff
Psychology
Humanities Graduate School Building
Upper Campus

Dear Dr Schrieff

PROJECT TITLE: IMPLEMENTATION OF AN ATTENTION TRAINING PROGRAM IN CHILDREN WITH TRAUMATIC BRAIN INJURY IN SOUTH AFRICA

Thank you for your letter to the Faculty of Health Sciences Human Research Ethics Committee dated 8th December 2013.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

We acknowledge that the student, Tali Lanesman is also involved in this study.

Approval is granted for one year until the 30th January 2015

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/research/humanethics/forms)

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC reference no in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN ETHICS
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938
This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

HREC Ref 597/2013

Note. Ethical approval is renewed annually.

APPENDIX B

Participation Information Sheet for Parents of Children with TBI

Researcher: Tali Lanesman
E-mail address: tali.lanesman@gmail.com
Tel: 0828121224
Supervisor: Leigh Schrieff
E-mail address: l.e.schrieff@gmail.com
Tel: 0216503708

Dear Parent/Guardian

My name is Tali Lanesman and I am currently completing my Masters in Clinical Neuropsychology at the University of Cape Town. I would like to invite you and your child to participate in my research, which is in partial fulfillment of my degree.

For my research, I am focusing on children who have sustained traumatic brain injuries (TBIs). As I'm sure you are well aware, children who have sustained a TBI may have difficulties with every day activities such as completing school work on time, or paying attention during tasks such as getting ready for school. Currently in South Africa, there are limited neuropsychological rehabilitation services for children following their TBI. There are a however programs that are offerered in rehabilitation centres in other parts of the world. Some of these programs are focused on attention and memory. For my research I would like to evaluate one of these programs: an attention training program. Because there is very limited research on this and other interventions of this nature, especially with children who have sustained TBIs, I cannot say whether it will definitely improve your child's attentional functioning. Part of the aim of this research is to investigate whether the program might lead to some improved attentional and memory functioning.

Your child will need to participate in approximately 3 hours of neuropsychological testing before and after the intervention, so that we can assess if the program has been successful. You will also be required to fill out some questionnaires regarding your child's overall functioning. All testing will take place on one day at a time that is convenient for you, and transportation costs will be compensated. Regular breaks will be given, however if you feel that your child may not be able to concentrate for this amount of time, we can arrange for testing to take place over 2 days.

In order to ensure that my results are accurate, I will need to compare the results of children who take part in the intervention, to children who do not take part in them. I will be recruiting 5 children who receive the attention training program in the beginning, 5 children who receive

Researcher: Tali Lanesman
E-mail address: tali.lanesman@gmail.com
Tel: 0828121224
Supervisor: Leigh Schrieff
E-mail address: l.e.schrieff@gmail.com
Tel: 0216503708

art therapy/classes with a clinical psychologist, and 5 children who will only be tested initially. The researcher will divide and match children with TBI into 3 groups based on their age, gender and injury severity. These three groups will then be randomly assigned to the Intervention Group, Art Group or Test-only Group. Should the attention training program be successful, then the children in the art group and the test-only group will also receive this intervention.

If your child is either 7 or 8 years of age, sustained a moderate-to-severe TBI 1 – 2 years ago, and has attentional deficits as a result of the TBI, you are eligible to participate in the study. However, if you child has any developmental (e.g. learning disability), neurological (e.g. epilepsy, infantile meningitis) or psychiatric difficulties (e.g. depression) that were evident prior to the TBI, you are ineligible to participate in this study.

Please note that participation is entirely voluntary and you may withdraw from the study at any time without stating a reason. Withdrawal will not disadvantage you in any way. Anonymity and confidentiality will be ensured as no names will be used in my report or on the test papers, and only my supervisors and I will be able to view the test scores. Results of the study will be made available to you upon completion of the study, and the findings may be published in a scientific journal.

Should you wish to participate in my study or require more information, please contact me at your earliest convenience. Pre-testing will begin mid-January, and the program will commence in February.

Kind regards,

Tali Lanesman
0828121224
tali.lanesman@gmail.com

Leigh Schrieff
0216503708
l.e.schrieff@gmail.com

APPENDIX C

Participation Information Sheet for Parents of Children with ADHD

Researcher: Tali Lanesman
E-mail address: tali.lanesman@gmail.com
Tel: 0828121224
Supervisor: Leigh Schrieff
E-mail address: l.e.schrieff@gmail.com
Tel: 0216503708

Dear Parent/Guardian,

My name is Tali Lanesman and I am currently completing my Masters in Clinical Neuropsychology at the University of Cape Town. I would like to invite you and your child to participate in my research, which is in partial fulfillment of my degree.

For my research, I am focusing on evaluating an attention training program for children who have sustained traumatic brain injuries (TBIs). Similar to children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD), children who have have sustained a TBI may have difficulties with every day activities such as completing school work on time, or paying attention during tasks such as getting ready for school. International studies have shown that this attention training program is successful in improving attention in children who have been diagnosed with ADHD, and school work tends to improve. However, the program has not yet been studied in children in South Africa with ADHD, or in children with TBI. Because there is very limited research on this and other interventions of this nature, I cannot say whether it will definitely improve your child's attentional functioning. Part of the aim of this research is to investigate whether the program might lead to some improved attentional and memory functioning.

Your child will need to participate in approximately 3 hours of neuropsychological testing before and after the intervention, so that we can assess if the program is successful. You will also be required to fill out some questionnaires regarding your child's overall functioning. All testing will take place on one day at a time that is convenient for you, and transportation costs will be compensated. Regular breaks will be given, however if you feel that your child may not be able to concentrate for this amount of time, we can arrange for testing to take place over 2 days.

I am recruiting 5 children who have been diagnosed with ADHD to take part in the intervention. If your child is either 7 or 8 years of age, and has been diagnosed with ADHD according to the DSM-V you are eligible to participate in this study. Children will be able to

Researcher: Tali Lanesman
E-mail address: tali.lanesman@gmail.com
Tel: 0828121224
Supervisor: Leigh Schrieff
E-mail address: l.e.schrieff@gmail.com
Tel: 0216503708

participate if they are currently taking medications such as Ritalin or Concerta, and if they are not taking medication, as long as theur medication does not change during the intervention and testing. However, if your child has any developmental (e.g. learning disability), neurological (e.g. epilepsy, infantile meningitis) or psychiatric difficulties (e.g. depression), you are ineligible to participate in this study. Your child will also need to match the children with TBI in my study, based on age and gender. For this reason, it is possible that your child may not be selected to participate in this research next year. However, this research is part of a bigger study and will continue to run over the next few years. In this case, I will contact you at a later stage when we are recruiting more children with ADHD.

Please note that participation is entirely voluntary and you may withdraw from the study at any time without stating a reason. Withdrawal will not disadvantage you in any way. Anonymity and confidentiality will be ensured as no names will be used in my report or on the test papers, and only my supervisors and I will be able to view the test scores. Results of the study will be made available to you upon completion of the study, and the findings may be published in a scientific journal.

Should you wish to participate in my study or require more information, please contact me at your earliest convenience. Pre-testing will begin mid-January, and the program will commence in February.

Kind regards,

Tali Lanesman
0828121224
tali.lanesman@gmail.com

Leigh Schrieff
0216503708
l.e.schrieff@gmail.com

APPENDIX D

Permission to Access Schools from the Western Cape Education Department

Western Cape Government
Education

Directorate: Research

Audrey.wyngaard2@pgwc.gov.za
tel: +27 021 467 9272
Fax: 0865902282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 20140304-25820
ENQUIRIES: Dr A T Wyngaard

Ms Talia Lanesman
PO Box 13755
Mowbray
7705

Dear Ms Talia Lanesman

RESEARCH PROPOSAL: IMPLEMENTATION OF AN ATTENTION TRAINING PROGRAM IN CHILDREN WITH TRAUMATIC BRAIN INJURY IN SOUTH AFRICA

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **17 March 2014 till 31 July 2014**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

    The Director: Research Services
    Western Cape Education Department
    Private Bag X9114
    CAPE TOWN
    8000

We wish you success in your research.

Kind regards.
Signed: Dr Audrey T Wyngaard
Directorate: Research
DATE: 05 March 2014

APPENDIX E

Permission to Access RXH Folders

Dr TA Blake
Manager: Medical Services
Email: Thomas.Blake@pgwc.gov.za
Tel: +27 21 658 5788 fax: +27 21 658 5166
10 February 2014

Ms T Lanesman

Dept Neuropsychology

Dear Ms Lanesman,

RE: RESEARCH: IMPLEMENTATION OF AN ATTENTION TRAINING INTERVENTION FOR CHILDREN WITH TRAUMATIC BRAIN INJURIES.

You may proceed with the research at the Red Cross War Memorial Children's Hospital. This letter serves as approval to proceed.

Please present this to Ms N Esau at the Medical Records Department.

Yours faithfully,

_____
DR T A BLAKE
CHAIRPERSON
HOSPITAL RESEARCH REVIEW COMMITTEE

APPENDIX F

Ethical Approval for an Amendment to the Study from the University of Cape Town Faculty of Health Sciences

UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

HUMAN RESEARCH ETHICS COMMITTEE
14 APR 2014
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

Form FHS006: Protocol Amendment

HREC office use only (FWA00001637; IRB00001938)		
☑ Approved	☑ Type of review: Expedited	☐ Full committee
This serves as notification that all changes and documentation described below are approved.		
Signature Chairperson of the HREC		Date 14/4/2014

Note: All amendments should include a synopsis justifying the changes for the amendment (please see notice dated 23 April 2012)

Principal Investigator to complete the following:

1. Protocol information

Date form submitted	12/03/14		
HREC REF Number	597/2013		
Protocol title	Implementation of an Attention Training Program in Children with Traumatic Brain Injury in South Africa		
Protocol number (if applicable)			
Principal Investigator	Dr. Leigh Schrieff		
Department / Office Internal Mail Address	l.e.schrieff@gmail.com		
1.1 Is this a major or a minor amendment? (see FHS006hlp)		☐ Major	■ Minor
1.2 Does this protocol receive US Federal funding?		☐ Yes	■ No
1.3 If the amendment is a major amendment and receives US Federal Funding, does the amendment require full committee approval?		☐ Yes	■ No

2. List of Proposed Amendments with Revised Version Numbers and Dates

Please itemise on the page below, all amendments with revised version numbers and dates, which need approval. This page will be detached, signed and returned to the PI as notification of approval. Please add extra pages if necessary.
Updated protocol version 3, dated 12/03/14 Updated A Letter of Participation for Children with TBI version 3, dated 12/03.14 Updated Letter of Participation for Children with ADHD version 3, dated 12/03.14

APPENDIX G

Demographic Questionnaire and Asset Index

PARENT QUESTIONNAIRE AND ASSET INDEX

GENERAL INFORMATION

Full name (Parent):	
Telephone:	Work: ( ) Home: ( ) Cell:
How would you describe your ethnicity / race?	1. Black 2. Coloured 3. White 4. Asian 5. Other(specify):
Home Language:	
Full name (Child):	
Gender:	M F
Date of Birth:	
Grade:	

HOUSEHOLD INCOME: (Please circle appropriate number)

Household income per year:	1. R0 2. R1 – R5 000 3. R5001 – R25 000 4. R25 000 – R100 000 5. R100 001+

PARENTAL EDUCATION: (Please circle appropriate number)

	Biological mother	Biological father	Guardian
Highest level of education reached? Mark one response for each person as follows:			
1. 0 years (No Grades / Standards) = No formal education (never went to school)	1.	1.	1.
2. 1-6 years (Grades 1-6 / Sub A-Std 4) = Less than primary education (didn't complete primary school)	2.	2.	2.
3. 7 years (Grade 7 / Std 5) = Primary education (completed primary school)	3.	3.	3.
4. 8-11 years (Grades 8-11 / Stds 6-9) = Some secondary education (didn't complete high school)	4.	4.	4.
5. 12 years (Grade 12 / Std 10) = Secondary education (completed senior school)	5.	5.	5.
6. 13+ years = Tertiary education (completed university / technikon / college)	6.	6.	6.
7. Don't know	7.	7.	7.

PARENTAL EMPLOYMENT: (Please circle appropriate number)

Hollingstead categories:	Biological mother	Biological father	Guardian
1. Higher executives, major professionals, owners of large businesses)	1.	1.	1.
2. Business managers of medium sized businesses, lesser professions (e.g. nurses, opticians, pharmacists, social workers, teachers)	2.	2.	2.
3. Administrative personnel, managers, minor professionals, owners / proprietors of small businesses (e.g. bakery, car dealership, engraving business, plumbing business, florist, decorator, actor, reporter, travel agent)	3.	3.	3.
4. Clerical and sales, technicians, small businesses (e.g. bank teller, bookkeeper, clerk, draftsperson, timekeeper, secretary)	4.	4.	4.
5. Skilled manual – usually having had training (e.g. baker, barber, chef, electrician, fireman, machinist, mechanic, painter, welder, police, plumber, electrician)	5.	5.	5.
6. Semi-skilled (e.g. hospital aide, painter, bartender, bus driver, cook, garage guard, checker, waiter, machine operator)	6.	6.	6.
7. Unskilled (e.g. attendant, janitor, construction helper, unspedified labour, porter, unemployed)	7.	7.	7.
8. Homemaker	8.	8.	8.
9. Student, disabled, no occupation	9.	9.	9.

MATERIAL AND FINANCIAL RESOURCES (ASSET INDEX): (Please circle appropriate number)

Which of the following items, in working order, does your household have?

Items	Yes	No
1. A refrigerator or freezer	1.	1.
2. A vacuum cleaner or polisher	2.	2.
3. A television	3.	3.
4. A hi-fi or music center (radio excluded)	4.	4.
5. A microwave oven	5.	5.
6. A washing machine	6.	6.
7. A video cassette recorder or dvd player	7.	7.

Which of the following do you have in your home?

Items	Yes	No
1. Running water	1.	1.
2. A domestic servant	2.	2.
3. At least one car	3.	3.
4. A flush toilet	4.	4.
5. A built-in kitchen sink	5.	5.
6. An electric stove or hotplate	6.	6.
7. A working telephone	7.	7.

Do you personally do any of the following?

Items	Yes	No
1. Shop at supermarkets	1.	1.
2. Use any financial services such as a bank account, ATM card or credit card	2.	2.
3. Have an account or credit card at a retail store	3.	3.

APPENDIX H

Description of Measures Used in the Study

Measures

Demographic information. A demographic questionnaire that assesses demographic information, SES background and asset index was administered to parents/caregivers/guardians of participants (Appendix G). The questionnaire enquires about general parental information such as race and home language, highest level of education, nature of employment, and household income per year. The asset index enquires about ownership of household assets such as fridges and televisions, as well as material resources such as running water and flushing toilets (Myer, Stein, Grimsrud, Seedat, & Williams, 2008). According to Myer, Ehrlich, and Susser (2004), some of these material resources are traditional measures of SES that are not suitable for developing countries such as South Africa, as access to facilities like running water is significantly limited compared to more developed countries. Lastly, access to financial resources such as a bank account is queried. Using this measure, an asset index is calculated. A score of 0-5 represents a low asset ownership, 6-12 represents a medium asset ownership, and 13-17 is high asset ownership (Myer et al., 2008).

General intellectual functioning.

Wechsler Abbreviated Scale of Intelligence (WASI). This intelligence test is used to assess general intellectual functioning in individuals aged 6 – 89. The WASI consists of four subtests, which measure an individual's Full Scale IQ (FSIQ): Vocabulary, Similarities, Block Design and Matrix Reasoning. Vocabulary and Similarities give a measure of the participant's Verbal IQ (VIQ). Block Design and Matrix Reasoning give a measure of the participant's Performance IQ (PIQ; Wechsler, 1999).

Vocabulary. This is a 42-item subtest that assesses language development and vocabulary acquisition. For the first four items, children are required to name pictures presented to them. For the rest of the items, children are required to provide definitions for words read aloud to them.

Similarities. This is a 26-item subtest that assesses verbal concept formation and categorical reasoning. For the first four items, the examinees are presented with a page with two rows of pictures. There are three thematically related pictures in the top row, and four pictures on the bottom row. The examinee has to identify which picture in the bottom row is

thematically related to the pictures in the top row. For items 5 to 26, two words are presented to the participant, who is required to explain how they are related.

Block Design. This is a 13-item subtest that measures perceptual organization, spatial visualization, visual-motor coordination, and abstract conceptualization. Participants are given three-dimensional cubes with red and white patterns on them. They are shown progressively more complete designs, that they are required to replicate using these cubes.

Matrix Reasoning. Matrix reasoning is a 35-item subtest that assesses nonverbal reasoning and mental perception of relationships between abstract symbols. Examinees are required to view an incomplete matrix consisting of four to nine components. They are required to select the missing component from five options presented below the matrix.

Psychometric properties. Test-retest reliabilities for the four subtests range from .92 to .95., and from .81 to .97 in a pediatric population range. Inter-correlations between subtests range between .50 and .70. When content validity was examined in relation to the WISC-III, correlations for the VIQ, PIQ and FSIQ were .82, .76 and .87 respectively (Wechsler, 1999). The WASI therefore demonstrates at least moderate construct validity. This test was only used as a pre-test measure to establish baseline, as general intelligence is not expected to improve post-intervention.

Applicability to the study. The WASI has been used in many published South African studies on children and adolescents (Donald, Mathema, Thomas & Wilmshurst, 2011; Ferrett, Carey, Thomas, Tapert, & Fein, 2010; Hoare et al., 2012; Hoogenhout & Malcolm-Smith, 2014), and adults with TBI (Lipinska, Timol, Kaminer & Thomas, 2014; Lochner et al., 2012; Roos, Fouché, Stein, & Lochner, 2013; Suliman, Troeman, Stein & Seedat, 2014).

Attention and working memory.

The Test of Everyday Attention for Children (TEA-Ch). The TEA-Ch is used to assess selective, sustained and divided attention as well as attentional control through visual, motor and auditory modalities in children aged 6 - 16 (Manly et al., 1999, 2001). The test consists of nine subtests. Version A was administered at pre-test, and version B was administered at post-test, in order to reduce practice effects. The brief screening version of the TEA-Ch consists of four out of the nine subtests, namely Sky Search, Score!, Creature Counting, and Sky Search Dual Task (DT). However, many of children were unable to attempt the Creature Counting subtest because they could not count backwards from 10 to 0. The Same World/Opposite World subtest, which also measures attentional control / switching, was therefore used as a substitute.

Sky Search. This subtest is used to measure selective and focused attention, and contains two components: an attention task and a motor task. In the attention component, examinees are presented with a page of rocket ships, and are required to circle pairs of target ships as quickly as they can while ignoring distractor pairs of ships. In the motor control component, examinees are required to repeat the task, except there are no distractor ships on the page. The score from the latter test is subtracted from the former to yield a score that accounts for motor slowness.

Score! This subtest is a measure of auditory sustained attention. An audio recording of scoring sounds at varying time intervals is played, and children are required to keep a mental count of the sounds across 10 games.

Same World/Opposite World. This is a timed subtest that is used to assess attentional control and switching. Children are presented with numbers '1' and '2' in a random array. In the 'same world' condition, children are required to name the numbers as they are. In the 'opposite world' condition, children are required to name '1' as '2', and '2' as '1'.

Sky Search DT. This subtest provides a measure of sustained and divided attention. As described in the Sky Search subtest, children are required to circle as many target spaceships as possible amidst distractor spaceships. However, in this subtest, children are also required to keep a mental count of auditory tones played in the background, as in the Score! subtest.

Psychometric properties. The TEA-Ch has test-retest reliabilities ranging from .57 to .87, and has demonstrated good construct and convergent validity through a structural equation model (Manly et al., 1999).

Applicability to the study. It has been used to assess attention in children with pTBI (Anderson, Fenwick, Manly, & Robertson, 1998; Catroppa et al., 2007; Manly et al., 1999). Only one South African study that used the TEA-Ch has been published, where researchers used the adult version of the test (Powell, 2000). However, it has shown good cross-cultural applicability in China in healthy children (Chan, Wang, Ye, Leung, & Mok, 2008), in children from LAMIC backgrounds in Brazil (Engel de Abreu et al., 2014), and in Kenya when two subtests, the Pencil-Tap test and the Code Transmission test, were successfully adapted to examine children with malaria (Halliday et al., 2012).

The Conners' Continuous Performance Test II (CPT-II). The CPT-II is a computerised measure of neurological functioning that is sensitive to attention and learning disorders. It can be used for diagnostic purposes as well as to monitor the effects of treatment and rehabilitation interventions. The test can be used to identify areas of difficulty such as

impulsiveness or vigilance in children aged 6 or older.

Participants are presented with letters that flash on a computer screen, and are required to press the space bar when any letter other than the target letter (e.g. X) appears. Letters are displayed at intervals of 250ms, 1s, 2s, and 4s. The computer software records scores for the participant's response time, changes in consistency, as well as errors of commission and omission (Conners & MHS Staff, 2000).

Psychometric properties. Test-retest reliability ranges from .05 to .92, and split-half reliabilities range from .66 to .95. The CPT-II discriminates between ADHD and non-clinical samples (Conners & MHS Staff, 2000).

Applicability to the study. This test has been used internationally to assess attention in children who have sustained a TBI (Allen et al., 2009, 2010; Galbiati et al., 2009; Park et al., 2009), and it has been used in South Africa to assess children with ADHD (Buckle, Franzsen, & Bester, 2011).

The Children's Memory Scale (CMS). The CMS is a comprehensive memory and learning test normed on individuals aged 5 to 16. The subtests measure attention and working memory, verbal and visual memory, short- and long- delay memory, spontaneous recall, and recognition (Cohen, 1997). I used the Numbers subtest of the CMS to measure concentration and working memory.

Numbers. This subtest consists of two components. In the first component, Numbers forward, participants are read a series a numbers and are asked to repeat them. Each string of numbers becomes increasingly longer, which provides a measure of attentional capacity. In the second component of the subtest, Numbers backward, participants are again read a series of numbers, but this time they are required to repeat them to the examiner in the reverse order, thereby giving a measure of working memory (Cohen, 1997).

Psychometric properties. The reliability coefficients of the core subtests range from .61 to .93, and supplemental subtests range from .65 to .93. Content validity coefficients range from .06 to .96. Criterion validity has been demonstrated as children from clinical populations (i.e. epilepsy, TBI, brain tumours) tend to perform more poorly when compared to matched controls (Cohen, 1997).

Applicability to the study. The CMS battery has frequently been used in brain injury research (e.g., see Hawley, 2004, 2005; Vella et al., 2007), as well as in the South African context (e.g., Donald et al., 2011; see Ferrett et al., 2010; 2011).

Inhibition

NEPSY-II. The NEPSY-II consists of 32 subtests that measure the domains of attention and executive function, language, memory and learning, social perception, sensorimotor, and visuospatial processing in children aged 5 – 16 (Korkman, Kirk, & Kemp, 2007). I only used the inhibition subtest of the NEPSY-II for this study.

Inhibition. Some studies have used the Stroop test to assess the effects of 'Pay Attention!' (Chenault et al., 2006; Kerns et al., 1999). In this test, over-learned verbal responses need to be inhibited while a conflicting response is required. The Inhibition subtest of the NEPSY-II is based on the principles of the Stroop test, however, it does not require a child to be literate (Korkman et al., 2007). Many children with pTBI have difficulties reading (Catroppa & Anderson, 2004; Ewing-Cobbs & Barnes, 2002; Ewing et al., 2004) and literacy rates are generally low in South Africa. Therefore, the Inhibition subtest is usually a preferred equivalent to the Stroop in South African pediatric clinical practice.

This subtest has three conditions: naming, inhibiting, and switching. These conditions are repeated in two trials. In the first trial, black and white shapes (circles and squares) are presented. In the second trial, black and white arrows (up and down) are presented. In the Naming condition, examinees are required to name the stimuli, which are the types of shapes or the directions of the arrows. In the inhibition condition, children are required to give the alternate response for the stimulus, meaning that they should say 'circle' when they see a square and vice-versa, and 'up' when they see a down arrow, and vice-versa. In the switching condition, participants are asked to say the correct name of the shape or direction of the arrow when the stimulus is black, but say the alternate response when the shape or arrow is white (Korkman et al., 2007). Although the switching component of this test was administered pre- and post-intervention, few children could complete the task and so the data for this trial was not included in the analyses.

Psychometric properties. Stability coefficients range from .62 to .89 and strong content and construct validity has been demonstrated. The NEPSY has demonstrated cross-cultural applicability in Zambian and American children, as language, culture and education did not significantly affect scores (Mulenga, Ahonen, & Aro, 2001).

Applicability to the study. The NEPSY has been used in South African research (Hoogenhout & Malcolm-Smith, 2014; Kodituwakku et al., 2006), and the Inhibition subtest in particular has been used to assess executive function in South African children (Hoare et al., 2012).

Memory

Children who sustain a TBI often have memory deficits (Anderson et al., 2000; 2001b; 2005; Lah, Epps, Levick, & Parry, 2011; Yeates et al., 2002). If children can better attend to information, then they may be able to better encode the information. Therefore, a verbal memory subtest and a visual memory subtest from the CMS were included in the battery.

CMS.

Dot Locations. This subtest is a measure of visuospatial learning and memory. Children are shown a page with blue dots on it for 5 seconds, and are then asked to place blue plastic chips on a grid in the same places as where the dots were. This task is repeated two more times, and then a distractor picture is shown for 5 seconds, which consists of red dots that are arranged differently compared to the blue dots. The child is asked to recall where the red dots were by placing the same blue chips in the correct locations on the grid. Participants are then asked to reproduce the first arrangement of blue dots they were presented with, without seeing the stimuli again. Lastly, the delayed recall component requires participants to recall the location of the dots 25-30 minutes after the immediate recall of the dots (Cohen, 1997).

Word List. This subtest measures a child's ability to learn and recall a list of words across four trials. For the first trial, the examiner reads a list of ten semantically unrelated words to the child, who is asked to recall as many words as they can in any order. For the subsequent trials, the examiner reads only the omitted words from the previous trial to the child. The child is asked to recall as many words as possible, including words already recalled. After the third trial, the examiner reads a distractor list of ten words to the child, who is asked to recall as many of the new words as possible, in any order. Children are then asked to remember as many words as the can from the original list. Approximately 25 – 30 minutes later, children are again required to recall the words from the original list. (Cohen, 1997)

Parent- and teacher-reported functional outcomes.

Behaviour Rating Inventory of Executive Function (BRIEF). This 86-item questionnaire provides a measure of parents' and teachers' observations of a child's executive function behaviours at home and in school (Gioia et al., 2000). It is targeted at parents and teachers who are responsible for children aged 5 to 18 years, particularly in cases where children are impaired in various ways. The scales measure eight domains of executive

functioning: Inhibit, Shift, Emotional Control, Initiate, Working Memory, Plan/Organise, Organisation of Materials, and Monitor. It takes 10-15 minutes to complete this assessment. Parents and teachers completed the relevant versions of the questionnaire. Lower scores on this measure indicate that a child's executive functions are within normal limits ($t < 50$), while higher scores indicate that the child's behaviours are in a borderline or more clinically significant range (Gioia et al., 2000).

Psychometric properties. Internal consistency for parent and teacher forms in normative and clinical samples ranges from .80 to .98. Test-retest reliabilities range from .72 to .92 in parent and teacher forms for normative samples, and in parent forms for clinical samples. Content and construct validity has been high in various samples (Gioia et al., 2000).

Cross-cultural applicability. The BRIEF has been used in a multinational collaborative study that includes South Africa to assess children and adolescents with FASD (Mattson, Crocker, & Nguyen, 2011). Cross-cultural applicability has also been demonstrated in a sample of Han Chinese children with ADHD and in Han Chinese children with both ADHD and oppositional defiant disorder (Qian, Shuai, Cao, Chan, &Wang, 2010).

The Child Behaviour Checklist (CBCL). The CBCL assesses behavioural competencies and problems in children and adolescents aged 6 – 18. The instrument requires parents/guardians and teachers to respond to questions regarding the child's behaviour, participation in sports and activities, their friendships and relationships, and school functioning. Some questions are open-ended and others are responded to on a 3-point Likert-type scale of "very often true"; "somewhat or sometimes true"; or "never true". Parents and teachers completed the relevant versions of the questionnaire. Lower scores ($t < 67$)on this measure indicate that a behaviour is within normal limits, while higher scores indicate that a child's functioning is in a borderline or more clinically significant range (Achenbach & Edelbrock, 1983).

Psychometric properties. The CBCL has test-retest reliability of .95 - 1.00, inter-rater reliability coefficients of .93 - .96 and internal consistency coefficients of .78-.97 (Achenbach & Edelbrock, 1983; Albores-Gallo et al., 2007).

Cross-cultural applicability. This test has been used previously in studies in South Africa (Boyes, Cluver, & Gardner, 2012; Cluver, Operario & Gardner, 2009; Donald et al., 2011; Palin et al., 2009). There are currently 85 translations of the CBCL and its cross-cultural applicability has been demonstrated in numerous studies (Wild, Furtado, & Angalakuditi, 2012).

The Vineland Adaptive Behaviour Scales-II (VABS-II). The Vineland-II is a measure of adaptive behaviour and daily function that is appropriate for individuals from birth to the age of 90. The test can be administered using the Survey Interview Form, Parent/Caregiver rating form, an Expanded Interview form, and a Teacher Rating Form. The Parent/Caregiver rating form was selected for parents to complete, as it is the quickest to administer, and there were time constraints during the assessments (Sparrow et al., 2005).

The Parent/Caregiver Rating Form consists of 433 items. Parents are required to mark a 2 next to an item if their child usually performs the behaviour without assistance, a 1 if the child sometimes performs the behaviour without assistance, and a 0 if their child never performs the behaviour without help or reminders. Lower scores on this measure indicate that a behaviour or skill is in a more clinically significant or elevated range (v <12), while higher scores indicate that a child's functioning is more within normal limits or above average (Sparrow et al., 2005).

Four domains each with two to three subdomains are assessed across the tests: Communication (receptive, expressive, written), Daily Living Skills (personal, domestic, community), Socialization (interpersonal relationships, play and leisure time, coping skills) and Motor Skills (gross, fine). The optional Motor Skills domain was not administered as the intervention was not expected to affect those skills, however the optional Maladaptive Behaviour domain was included. The Maladaptive Behavior domain assesses problem behaviours (Sparrow et al., 2005).

Psychometric properties. Subdomain internal consistencies range from .70 to .95, and subdomain test-retest reliability coefficients are high, with most values above .85. Inter-rater reliabilities are in the mid to low .70s for domains and subdomains for children aged 7-18. Intercorrelations between subdomains are moderate. Subdomain correlations are larger than correlations between domains, thus indicating construct validity.

Applicability to the study. The test has been normed on children with ADHD (Sparrow et al., 2005), and used in numerous studies on children who have sustained a TBI (Anderson & Catroppa, 2005; Catroppa et al., 2007; Catroppa & Anderson, 2002; Power, Catroppa, Coleman, Ditchfield, & Anderson, 2007; Stancin et al., 2002). The Vineland-II has previously been used in South African research (Ebersöhn et al., 2012).

APPENDIX I

Parental Consent Form for Pre-Testing Children in the TBI Groups

Informed Consent for you and your child to participate in research and authorization for collection, use, and disclosure of neuropsychological rehabilitation and cognitive performance, and other personal data

You are being asked to allow your child to take part in a research study. This form provides you with information about the study and seeks your permission for the collection, use and disclosure of your child's neuropsychological rehabilitation and cognitive performance data, as well as other information necessary for the study. The Principal Investigator (the person in charge of this research) or a representative of the Principal Investigator will also describe this study to you and answer all of your questions. Your child's participation is entirely voluntary. Before you decide whether or not to allow your child to take part, read the information below and ask questions about anything you do not understand. By allowing your child to participate in this study you will not be penalized or lose any benefits to which you would otherwise be entitled.

1. Name of Participant ("Study Subject" – the child)

---

2. Title of Research Study

Implementation of an Attention Training Program in Children with Traumatic Brain Injury in South Africa

3. Principal Investigator(s) and Telephone Number(s)

Leigh Schrieff, Ph.D.
Psychology Department
University of Cape Town
021-650-3708

Tali Lanesman (Masters Student)
Psychology Department
University of Cape Town
tali.lanesman@gmail.com

4. Source of Funding or Other Material Support

National Research Foundation and the University of Cape Town's University Research Committee

5. What is the purpose of this research study?

The purpose of this research is to investigate the effectiveness of the Pay Attention! program in rehabilitating attention in children who have sustained a traumatic brain injury. This research was undertaken because of a need for such services in South Africa.

6. What will be done if you take part in this research study?

Firstly, we will ask you some questions about your child's development and their current functioning at school and at home. If we find that your child has any diagnosed neurological, developmental or psychiatric problems in addition to their traumatic brain injuries, then unfortunately they will not be able to participate in the study. This is because these types of problems may lead to different outcomes among those children who experience those problems as compared to those who do not.

We will also carry out some neuropsychological assessments. We will administer a series of tests that will examine your child's strengths and weakness, particularly with regards to his/her attention in various tasks. You will also be required to complete some forms so that we have a better understanding of your child's performance at home and at school. The Principal Investigator will also request that your child's teacher completes similar forms, so that we have a holistic understanding of your child's functioning. If these tests show us that your child has a problem with attention, then you are eligible for the study.

Children will then be divided into 3 groups and matched to other children with TBI based on age, sex, and injury severity. These 3 groups will then be randomly allocated to a group that receives the intervention, a group that receives art classes, and a group that will not receive any intervention. Should we find that the intervention is successful, we will offer it to the other two groups (the art group and the group that does not receive any therapy now) at a later stage.

You will then be asked to bring your child to UCT so that trainers can facilitate the intervention with your child. Your child will be asked to engage in various activities such as sorting cards and listening and responding to target sounds. The exercises may be easier at first and gradually become more complex as your child is able to master them.

After the intervention, your child will again be asked to receive another neuropsychological assessment. You and the child's teacher will also be asked to fill out some more questionnaires about your child's functioning. Results obtained from these tests will be compared to the first tests.

7. If you choose to participate in this study, how long will you be expected to participate in the research?

If you are placed in the Intervention Group or the Art Group, you will be asked to bring your child to UCT for 45 minutes twice a week for a period of 12 weeks. This will be arranged at a time that is convenient for you. Should you wish to participate in the study but are unable to bring your child to UCT, alternative arrangements can be made.

8. How many people are expected to participate in the research?

20 children and their parents/guardians/caregivers.

9. What are the possible discomforts and risks for you or your child?

There are no known risks associated with taking part in this study.

During the testing period we may find that your child may need assistance in other areas of functioning not covered by the current intervention. Should this happen, we will discuss this with you and give a referral for the necessary care. Children may also feel fatigued or irritable during testing, as the tasks require concentration. However, children will be given breaks where necessary as well as refreshments. Where necessary, testing can be split over 2 days.

If you wish to discuss the information above or any discomforts you may experience, you may ask questions now or call the Principal Investigators listed on the front page of this form.

Please note that the University of Cape Town carries a No Fault Clinical Liability policy for participants who suffer a research-related injury in researcher-initiated clinical research: http://www.health.uct.ac.za/usr/health/research/hrec/forms/No_Fault_Insurance_2013.pdf

10. What are the possible benefits to you and your child?

By you and your child partaking in the neuropsychological assessment, this will provide you

with a deeper understanding of the neuropsychological functioning of your child. We will also give you feedback on the results from the neuropsychological tests.

In terms of the wider study, the aim of this rehabilitation program is to implement and evaluate an intervention focused on improving attention. As part of this aim is to investigate how effective this intervention might be, it is not guaranteed that the attention-training program will result in improved functioning or performance for your child. It is important to bear this in mind at the outset of the study. However, part of the neuropsychological rehabilitation service is to provide you, the parent / caregiver, with useful advice regarding the management of your child in line with his / her areas of strengths and weaknesses.

11. What are the possible benefits to others?

Should this training program prove to be effective, this will be an important contribution to future neuropsychological rehabilitation services offered to other children who have sustained traumatic brain injuries. In other words, this research can then be applied to other children, or families of children, who have experienced a traumatic brain injury. It will also help to motivate the need for formal development of such services in South Africa.

12. If you choose to take part in this research study, will it cost you anything?

Participating in this study will not cost you anything.

13. Will you and your child receive compensation for taking part in this research study?

You will receive R50 per session for both participation and transport. Refreshments will be available at each of the assessments.

14. Can you and your child withdraw from this research study?

You may withdraw your consent and to stop participating in this research study at any time, without any penalty to you or your child. In addition, refusal to consent to participation in the study will not affect current or future health care.

If you have a complaint or complaints about your rights and welfare as research participants, please contact the Human Research Ethics Committee

Tel: 021 406 6492

E-mail: sumaya.ariefdien@uct.ac.za

15. If you withdraw, can information about you and your child still be used and/or collected?

Information that has already been collected may be used.

16. Once personal and performance information is collected, how will it be kept secret (confidential) in order to protect your privacy?

Information collected will be stored in locked filing cabinets or on computers with security passwords. Only the researcher and supervisors will have access to this information. Your research records will not be released without your permission unless required by law or a court order.

However, the researcher is obliged to report cases in which deliberate abuse or neglect is evident.

17. What information about you or your child may be collected, used and shared with others?

This information gathered from you will be demographic information, records of your responses, or your child's performance on the neuropsychological tests, and records of your child's progress in the intervention. If you agree to be in this research study, it is possible that some of the information collected might be copied into a "limited data set" (a computer file) to be used for other research purposes. If so, the limited data set may only include information that does not directly identify you or your child. For example, the limited data set cannot include you or your child's name, address, telephone number, ID number, or any other photographs, numbers, codes, or so forth that link you to the information in the limited data set.

18. How will the researcher(s) benefit from your being in the study?

This study is being conducted as a partial fulfillment for a Masters degree at the UCT. In addition, the researcher may choose to present this research at a conference or in a scientific journal.

Signatures

As a representative of this study, I have explained to the participant's (child's) parent the purpose, the procedures, the possible benefits, and the risks of this research study; and how the participant's performance and other data will be collected, used, and shared with others:

_____

Signature of Person Obtaining Consent and Authorization Date

You have been informed about this study's purpose, procedures, possible benefits, and risks; and how your responses and your child's performance and other data will be collected, used and shared with others. You have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time.

You voluntarily agree for you and your child to participate in this study. You hereby authorize the collection, use and sharing of your performance and other data. By signing this form, you are not waiving any of your legal rights.

_____

Signature of Person Consenting and Authorizing Date

Authorization for _____ to participate in the study.

Relationship to child participating in the study: parent / legal guardian

_____

Please indicate below if you would like to be notified of future research projects conducted by our research group: _____ (initial & surname) Yes, I would like to be added to your research participation pool and be notified of research projects in which I might participate in the future.

Method of contact:

Phone number: _____

E-mail address: _____

Mailing address: _____

_____

APPENDIX J

Parental Consent Form for Pre-Testing Children in the ADHD Group

Dear Parent,

Informed Consent for you and your child to participate in research and authorization for collection, use, and disclosure of neuropsychological rehabilitation and cognitive performance, and other personal data

You are being asked to allow your child to take part in a research study. This form provides you with information about the study and seeks your permission for the collection, use and disclosure of your child's neuropsychological rehabilitation and cognitive performance data, as well as other information necessary for the study. The Principal Investigator (the person in charge of this research) or a representative of the Principal Investigator will also describe this study to you and answer all of your questions. Your child's participation is entirely voluntary. Before you decide whether or not to allow your child to take part, read the information below and ask questions about anything you do not understand. By allowing your child to participate in this study you will not be penalized or lose any benefits to which you would otherwise be entitled. Please note this research has been approved by the Faculty of Science's Human Research Ethics Committee at the University of Cape Town (Insert REF number).

1. Title of Research Study

Implementation of an Attention Training Program in Children with Attention Deficit Hyperactivity Disorder in South Africa

2. Principal Investigator(s) and Telephone Number(s)

Leigh Schrieff, Ph.D.
Psychology Department
University of Cape Town
021-650-3708

Tali Lanesman (Masters Student)
Psychology Department
University of Cape Town
tali.lanesman@gmail.com

3. Source of Funding or Other Material Support

National Research Foundation and the University of Cape Town's research committee.

4. What is the purpose of this research study?

The purpose of this research is to investigate the effectiveness of the Pay Attention! program in rehabilitating attention in children who have sustained traumatic brain injuries (TBIs) and in children who have been diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). This research was undertaken because of a need for such services in South Africa.

5. What will be done if you take part in this research study?

Firstly, we will ask you some questions about your child's development and their current functioning at school and at home. If we find that your child has any diagnosed neurological or developmental problems in addition to their ADHD, then unfortunately they will not be able to participate in the study. This is because these types of problems may lead to different outcomes among those children who experience those problems as compared to those who do not.

We will also carry out some neuropsychological assessments, which will take approximately 3 hours. We will administer a series of tests that will examine your child's strengths and weakness, particularly with regards to his/her attention in various tasks. You will also be required to complete some forms so that we have a better understanding of your child's performance at home and at school. The Principal Investigator will also request that your child's teacher completes similar forms, so that we have a holistic understanding of your child's functioning. If these tests show us that your child has a problem with attention, then you are eligible for the study.

You will then be asked to bring your child to UCT for 45 minutes twice a week for a period of 12 weeks so that trainers can facilitate the intervention. Your child will be asked to engage in various activities such as sorting cards and listening and responding to target sounds. The exercises may be easier at first and gradually become more complex as your child is able to master them.

Your child will then be required to have another neuropsychological assessment. You and your child's teacher will also be required to complete some questionnaires. Results obtained from these tests will be compared to the first tests.

6. If you choose to participate in this study, how long will you be expected to participate in the research?

If your child has been randomly assigned to the intervention group or the art group you will be asked to bring your child to UCT for 45 minutes twice a week for a period of 12 weeks. This will be arranged at a time that is convenient for you. Should you wish to participate in the study but are unable to bring your child to UCT, alternative arrangements can be made. You will then be asked to bring your child back to UCT within 14 days of completion for your child to be assessed again for a period of approximately 2 hours.

7. How many people are expected to participate in the research?

20 children and their parents/guardians/caregivers.

8. What are the possible discomforts and risks for you or your child?

There are no known risks associated with taking part in this study.

During the testing period we may find that your child may need assistance in other areas of functioning not covered by the current intervention. Should this happen, we will discuss this with you and give a referral for the necessary care. Children may also feel fatigued or irritable during testing as the tasks require concentration. However, children will be given breaks where necessary as well as refreshments. Where necessary, testing can be split over 2 days.

If you wish to discuss the information above or any discomforts you may experience, you may ask questions now or call the Principal Investigators listed on the front page of this form.

Please note that the University of Cape Town carries a No Fault Clinical Liability policy for participants who suffer a research-related injury in researcher-initiated clinical research: http://www.health.uct.ac.za/usr/health/research/hrec/forms/No_Fault_Insurance_2013.pdf

Please not that this study will be conducted according to the International Declaration of Helsinki and other applicable international ethical codes for research on human subject.

9. What are the possible benefits to you and your child?

The aim of this rehabilitation program is to implement and evaluate an intervention focused on improving attention. As part of this aim is to investigate how effective this intervention might be, it is not guaranteed that the attention-training program will result in improved functioning or performance for your child. It is important to bear this in mind at the outset of the study. However, part of the neuropsychological rehabilitation service is to provide you, the parent / caregiver, with useful advice regarding the management of your child in line with his / her areas of strengths and weaknesses.

By you and your child partaking in the neuropsychological assessment, this will provide you with a deeper understanding of the neuropsychological functioning of your child.

10. What are the possible benefits to others?

Should this training program prove to be effective, this will be an important contribution to future neuropsychological rehabilitation services offered to other children who have been diagnosed with ADHD and to children who have sustained TBIs. In other words, this research can then be applied to other children, or families of children, who have experienced ADHD or TBI. It will also help to motivate the need for formal development of such services in South Africa.

11. If you choose to take part in this research study, will it cost you anything?

Participating in this study will not cost you anything.

12. Will you and your child receive compensation for taking part in this research study?

You will receive R50 per session, which is for both participation and transport. Refreshments will be available at each of the assessments.

13. Can you and your child withdraw from this research study?

You may withdraw your consent and stop participating in this study at any time, without any penalty to you or your child. In addition, refusal to consent to participation in the study will not affect current or future health care.

If you have a complaint or complaints about your rights and welfare as research participants, please contact the Human Research Ethics Committee

Tel: 021 406 492
E-mail: sumaya.ariefdien@uct.ac.za

14. If you withdraw, can information about you and your child still be used and/or collected?

Information that has already been collected may be used.

15. Once personal and performance information is collected, how will it be kept secret (confidential) in order to protect your privacy?

Information collected will be stored in locked filing cabinets or on computers with security passwords. Only the researcher and supervisors will have access to this information. Your research records will not be released without your permission unless required by law or a court order.

However, the researcher is obliged to report cases in which deliberate abuse or neglect is evident.

Please note that sponsors of the study, study monitors or auditors or REC members may need to inspect research records.

16. What information about you or your child may be collected, used and shared with others?

This information gathered from you will be demographic information, records of your responses, or your child's performance on the neuropsychological tests, and-records of your child's progress in the intervention. If you agree to be in this research study, it is possible that some of the information collected might be copied into a "limited data set" (a computer file) to be used for other research purposes. If so, the limited data set may only include information that does not directly identify you or your child. For example, the limited data set cannot include you or your child's name, address, telephone number, ID number, or any other photographs, numbers, codes, or so forth that link you to the information in the limited data set.

17. How will the researcher(s) benefit from your being in the study?

This study is being conducted as a partial fulfilment for a Masters degree at UCT. In addition, the researcher may choose to present this research at a conference or in a scientific journal.

Please note that this research is funded by the National Research Foundation. The researchers and funders declare that there are no financial or non-financial interests, which may inappropriately influence the conduct of this research study.

Signatures

As a representative of this study, I have explained to the participant's (child's) parent the purpose, the procedures, the possible benefits, and the risks of this research study; and how the participant's performance and other data will be collected, used, and shared with others:

_____

Signature of Person Obtaining Consent and Authorization Date

You have been informed about this study's purpose, procedures, possible benefits, and risks; and how your responses and your child's performance and other data will be collected, used and shared with others. You have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time.

You voluntarily agree for you and your child to participate in this study. You hereby authorize the collection, use and sharing of your performance and other data. By signing this form, you are not waiving any of your legal rights.

_____

Signature of Person Consenting and Authorizing Date

Authorization for _____ to participate in the study.

Relationship to child participating in the study: parent / legal guardian

_____

Please indicate below if you would like to be notified of future research projects conducted by our research group:

_____ (initial & surname) Yes, I would like to be added to your research participation pool and be notified of research projects in which I might participate in the future.

Method of contact:

Phone number: _____

E-mail address: _____

Mailing address: _____

_____

APPENDIX K

Assent Form for Pre-Testing

We would like you to be in our research study because we would like to learn more about children with head injuries and ways to help them. Today we will be playing some games that will help us understand how you pay attention and remember things.
For example, we may ask you to try to count, to remember things, to draw or to read things.

These exercises and activities will not hurt you, but some of them may be long and you may feel tired at times. If you do, you can stop and take a break at any time.

Signing this paper means that you will allow us to test your attention and memory. If you don't want us to test your attention and memory, don't sign the paper. No one will be cross if you don't sign this paper, and no one will be cross if you change your mind later and want to stop.

You can ask any questions that you have about the study. If you have a question later that you didn't think of now, you can call me on 0828121224 or ask me next time.

Signature of Participant _____ Date _____
Signature of Investigator _____ Date _____

APPENDIX L

Parental Consent Form for TBI- and ADHD-Intervention Group Participants

Informed Consent for you and your child to participate in research and authorization for collection, use, and disclosure of neuropsychological rehabilitation and cognitive performance, and other personal data

You are being asked to allow your child to take part in a research study. This form provides you with information about the study and seeks your permission for the collection, use and disclosure of your child's neuropsychological rehabilitation and cognitive performance data, as well as other information necessary for the study. The Principal Investigator (the person in charge of this research) or a representative of the Principal Investigator will also describe this study to you and answer all of your questions. Your child's participation is entirely voluntary. Before you decide whether or not to allow your child to take part, read the information below and ask questions about anything you do not understand. By allowing your child to participate in this study you will not be penalized or lose any benefits to which you would otherwise be entitled.

1. Name of Participant ("Study Subject" – the child)

---

2. Title of Research Study

Implementation of an Attention Training Program in Children with Traumatic Brain Injury in South Africa

3. Principal Investigator(s) and Telephone Number(s)

Leigh Schrieff, Ph.D.
Department of Psychology
University of Cape Town
021-650-3708

Tali Lanesman (Masters Student)
Department of Psychology
University of Cape Town
tali.lanesman@gmail.com

4. Source of Funding or Other Material Support

National Research Foundation and the University of Cape Town's University Research Committee

5. What is the purpose of this research study?

The purpose of this research is to investigate the effectiveness of the Pay Attention! program in rehabilitating attention in children who have sustained a traumatic brain injury. This research was undertaken because of a need for such services in South Africa.

6. What will be done if you take part in this research study?

Firstly, you and your child will be asked to come to the University of Cape Town so that we can carry out some neuropsychological assessments. We will administer a series of tests that will examine your child's strengths and weakness, particularly with regards to his/her attention in various tasks. You will also be required to complete some forms so that we have a better understanding of your child's performance at home and at school. The Principal Investigator will also request that your child's teacher completes similar forms, so that we have a holistic understanding of your child's functioning.

Children with TBI will be divided into 3 groups and matched to other children with TBI based on age, gender and injury severity. These 3 groups will then be randomly allocated to a group that receives the intervention, a group that receives art classes, and a group that will not receive any intervention this year. Children with ADHD will then be matched to these 3 groups based on age and gender, and will receive the intervention under investigation.

You will then be asked to bring your child to UCT so that trainers can facilitate theintervention with your child. Your child will be asked to engage in various activities such as sorting cards and listening and responding to target sounds. The exercises may be easier at first and gradually become more complex as your child is able to master them.

After the intervention, you and your child will again be requested to go to UCT for another neuropsychological assessment. Results obtained from these tests will be compared to the first tests.

7. If you choose to participate in this study, how long will you be expected to participate in the research?

You will be asked to bring your child to UCT for 1 hour twice a week for a period of 12 weeks. This will be arranged at a time that is convenient for you. Should you wish to

participate in the study but are unable to bring your child to UCT, alternative arrangements can be made.

8. How many people are expected to participate in the research?

20 children and their parents/guardians/caregivers.

9. What are the possible discomforts and risks for you or your child?

There are no known risks associated with taking part in this study.

During the testing period we may find that your child may need assistance in other areas of functioning not covered by the current intervention. Should this happen, we will discuss this with you and give a referral for the necessary care. Children may also feel fatigued or irritable during testing as the tasks require concentration. However, children will be given breaks where necessary as well as refreshments. Where necessary, testing can be split over 2 days.

If you wish to discuss the information above or any discomforts you may experience, you may ask questions now or call the Principal Investigators listed on the front page of this form.

Please note that the University of Cape Town carries a No Fault Clinical Liability policy for participants who suffer a research-related injury in researcher-initiated clinical research: http://www.health.uct.ac.za/usr/health/research/hrec/forms/No_Fault_Insurance_2013.pdf

10. What are the possible benefits to you and your child?

The aim of this rehabilitation program is to implement and evaluate an intervention focused on improving attention. As part of this aim is to investigate how effective this intervention might be, it is not guaranteed that the attention-training program will result in improved functioning or performance for your child. It is important to bear this in mind at the outset of the study. However, part of the neuropsychological rehabilitation service is to provide you, the parent / caregiver, with useful advice regarding the management of your child in line with his / her areas of strengths and weaknesses.

By you and your child partaking in the neuropsychological assessment, this will provide you with a deeper understanding of the neuropsychological functioning of your child.

11. What are the possible benefits to others?

Should this training program prove to be effective, this will be an important contribution to future neuropsychological rehabilitation services offered to other children who have sustained traumatic brain injuries. In other words, this research can then be applied to other children, or families of children, who have experienced a traumatic brain injury. It will also help to motivate the need for formal development of such services in South Africa.

12. If you choose to take part in this research study, will it cost you anything?

Participating in this study will not cost you anything.

13. Will you and your child receive compensation for taking part in this research study?

You will receive R50 per session, which is for both participation and transport. Refreshments will be available at each of the assessments.

14. Can you and your child withdraw from this research study?

You may withdraw your consent and to stop participating in this research study at any time, without any penalty to you or your child. In addition, refusal to consent to participation in the study will not affect current or future health care.

If you have a complaint or complaints about your rights and welfare as research participants, please contact the Human Research Ethics Committee
Tel: 021 406 6492
E-mail: sumaya.ariefdien@uct.ac.za

15. If you withdraw, can information about you and your child still be used and/or collected?

Information that has already been collected may be used.

16. Once personal and performance information is collected, how will it be kept secret (confidential) in order to protect your privacy?

Information collected will be stored in locked filing cabinets or on computers with security passwords. Only the researcher and supervisors will have access to this information. Your

research records will not be released without your permission unless required by law or a court order.

However, the researcher is obliged to report cases in which deliberate abuse or neglect is evident.

17. What information about you or your child may be collected, used and shared with others?

This information gathered from you will be demographic information, records of your responses, or your child's performance on the neuropsychological tests, and records of your child's progress in the intervention. If you agree to be in this research study, it is possible that some of the information collected might be copied into a "limited data set" (a computer file) to be used for other research purposes. If so, the limited data set may only include information that does not directly identify you or your child. For example, the limited data set cannot include you or your child's name, address, telephone number, ID number, or any other photographs, numbers, codes, or so forth that link you to the information in the limited data set.

18. How will the researcher(s) benefit from your being in the study?

This study is being conducted as a partial fulfillment for a Masters degree at the UCT. In addition, the researcher may choose to present this research at a conference or in a scientific journal.

Signatures

As a representative of this study, I have explained to the participant's (child's) parent the purpose, the procedures, the possible benefits, and the risks of this research study; and how the participant's performance and other data will be collected, used, and shared with others:

_____

Signature of Person Obtaining Consent and Authorization Date

You have been informed about this study's purpose, procedures, possible benefits, and risks; and how your responses and your child's performance and other data will be collected, used and shared with others. You have received a copy of this form. You have been given the

opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time.

You voluntarily agree for you and your child to participate in this study. You hereby authorize the collection, use and sharing of your performance and other data. By signing this form, you are not waiving any of your legal rights.

_____

Signature of Person Consenting and Authorizing Date

Authorization for _____ to participate in the study.

Relationship to child participating in the study: parent / legal guardian

_____

Please indicate below if you would like to be notified of future research projects conducted by our research group:

_____ (initial & surname) Yes, I would like to be added to your research participation pool and be notified of research projects in which I might participate in the future.

Method of contact:

Phone number: _____

E-mail address: _____

Mailing address: _____

APPENDIX M

Parental Consent Form for TBI Art Group Participants

Informed Consent for you and your child to participate in research and authorization for collection, use, and disclosure of neuropsychological rehabilitation and cognitive performance, and other personal data

You are being asked to allow your child to take part in a research study. This form provides you with information about the study and seeks your permission for the collection, use and disclosure of your child's neuropsychological rehabilitation and cognitive performance data, as well as other information necessary for the study. The Principal Investigator (the person in charge of this research) or a representative of the Principal Investigator will also describe this study to you and answer all of your questions. Your child's participation is entirely voluntary. Before you decide whether or not to allow your child to take part, read the information below and ask questions about anything you do not understand. By allowing your child to participate in this study you will not be penalized or lose any benefits to which you would otherwise be entitled.

1. Name of Participant ("Study Subject" – the child)

---

2. Title of Research Study

Implementation of an Attention Training Program in Children with Traumatic Brain Injury in South Africa

3. Principal Investigator(s) and Telephone Number(s)

Leigh Schrieff, Ph.D.
Department of Psychology
University of Cape Town
021-650-3708

Tali Lanesman (Masters Student)
Department of Psychology
University of Cape Town
tali.lanesman@gmail.com

4. Source of Funding or Other Material Support

National Research Foundation and the University of Cape Town's University Research Committee

5. What is the purpose of this research study?

The purpose of this research is to investigate the effectiveness of the Pay Attention! program in rehabilitating attention in children who have sustained a traumatic brain injury. This research was undertaken because of a need for such services in South Africa.

6. What will be done if you take part in this research study?

Firstly, you and your child will be asked to come to the University of Cape Town so that we can carry out some neuropsychological assessments. We will administer a series of tests that will examine your child's strengths and weakness, particularly with regards to his/her attention in various tasks. You will also be required to complete some forms so that we have a better understanding of your child's performance at home and at school. The Principal Investigator will also request that your child's teacher completes similar forms, so that we have a holistic understanding of your child's functioning.

Children with TBI will be divided into 3 groups and matched to other children with TBI based on age, gender and injury severity. These 3 groups will be randomly allocated to the group that receives the intervention, a group that receives art classes with a clinical psychologist, and a group that will not receive any intervention this year. Children with ADHD will then be matched to these 3 groups based on age and gender, and will receive the intervention under investigation.

You will then be asked to bring your child to UCT, where they will receive art therapy/classes from a HPCSA registered clinical psychologist. Art therapy is based on the idea that the creative process of making art allows for nonverbal communication of thoughts and feelings as well as self-expression.

After the intervention, you and your child will again be requested to go to UCT for another neuropsychological assessment. Results obtained from these tests will be compared to the first tests.

Your child will not immediately receive the 12-week attention rehabilitation program that is under investigation. Should we find positive results for the attention-training program, then it will be made available to you on completion of the study. In order to reliably assess whether

or not this program is successful, we will need to compare children who participate in the program to children who do not participate in it.

7. If you choose to participate in this study, how long will you be expected to participate in the research?

You will be asked to bring your child to UCT for 1 hour twice a week for a period of 12 weeks. This will be arranged at a time that is convenient for you. Should you wish to participate in the study but are unable to bring your child to UCT, alternative arrangements can be made.

However, if at any time during the research period you feel that you do not wish to continue, you are free to discontinue your participation without penalty.

8. How many people are expected to participate in the research?

20 children and their parents/guardians/caregivers.

9. What are the possible discomforts and risks for you or your child?

There are no known risks associated with taking part in this study. If the clinical psychologist feels that your child may benefit from continued therapy, or that it may be premature to stop the therapy after 12 weeks, you will be given a referral for continued therapy.

During the testing period we may find that your child may need assistance in other areas of functioning not covered by the current intervention. Should this happen, we will discuss this with you and give a referral for the necessary care.

Children may also feel fatigued or irritable during testing as the tasks require concentration. However, children will be given breaks where necessary as well as refreshments. Where necessary, testing can be split over 2 days.

If you wish to discuss the information above or any discomforts you may experience, you may ask questions now or call the Principal Investigators listed on the front page of this form.

Please note that the University of Cape Town carries a No Fault Clinical Liability policy for participants who suffer a research-related injury in researcher-initiated clinical research: http://www.health.uct.ac.za/usr/health/research/hrec/forms/No_Fault_Insurance_2013.pdf

10. What are the possible benefits to you and your child?

The aim of this study is to investigate how effective the Pay Attention! intervention will be for children who have sustained traumatic brain injuries. However, it is not guaranteed that the intervention will result in improved attention. Should the Pay Attention! program prove to be efficacious, this program will be offered to you upon completion of the study.

Although your child will not be engaging in the attention rehabilitation, art activities have been demonstrated to improve self-esteem and self-worth in children, and give them a means for expressing themselves in a safe and contained environment. This therapy is being offered to you without any expense.

Your child will also be receiving two neuropsychological test batteries, which could help give you an understanding of their recovery and development since their injury.

11. What are the possible benefits to others?

Should this training program prove to be effective, this will be an important contribution to future neuropsychological rehabilitation services offered to other children who have sustained traumatic brain injuries. In other words, this research can then be applied to other children, or families of children, who have experienced a traumatic brain injury. It will also help to motivate the need for formal development of such services in South Africa.

12. If you choose to take part in this research study, will it cost you anything?

Participating in this study will not cost you anything financially.

13. Will you and your child receive compensation for taking part in this research study?

You will receive R50 per session for both participation and transport. Refreshments will be available at each of the assessments.

14. Can you and your child withdraw from this research study?

You may withdraw your consent and to stop participating in this research study at any time, without any penalty to you or your child.

In addition, refusal to consent to participation in the study will not affect current or future health care.

If you have a complaint or complaints about your rights and welfare as research participants, please contact the Human Research Ethics Committee
Tel: 021 406 6492
E-mail: sumaya.ariefdien@uct.ac.za

15. If you withdraw, can information about you and your child still be used and/or collected?
Information that has already been collected may be used.

16. Once personal and performance information is collected, how will it be kept secret (confidential) in order to protect your privacy?
Information collected will be stored in locked filing cabinets or on computers with security passwords. Only the researcher and two supervisors will have access to this information. Your research records will not be released without your permission unless required by law or a court order.

However, the researcher is obliged to report cases in which deliberate abuse or neglect is evident.

17. What information about you or your child may be collected, used and shared with others?
This information gathered from you will be demographic information, records of your responses, or your child's performance on the neuropsychological tests, and records of your child's progress in the intervention. If you agree to be in this research study, it is possible that some of the information collected might be copied into a "limited data set" (a computer file) to be used for other research purposes. If so, the limited data set may only include information that does not directly identify you or your child. For example, the limited data set cannot include you or your child's name, address, telephone number, ID number, or any other photographs, numbers, codes, or so forth that link you to the information in the limited data set.

18. How will the researcher(s) benefit from your being in the study?

This study is being conducted as a partial fulfillment for a Masters degree at UCT. In addition, the researcher may choose to present this research at a conference or in a scientific journal.

Signatures

As a representative of this study, I have explained to the participant's (child's) parent the purpose, the procedures, the possible benefits, and the risks of this research study; and how the participant's performance and other data will be collected, used, and shared with others:

_____

Signature of Person Obtaining Consent and Authorization Date

You have been informed about this study's purpose, procedures, possible benefits, and risks; and how your responses and your child's performance and other data will be collected, used and shared with others. You have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time.

You voluntarily agree for you and your child to participate in this study. You hereby authorize the collection, use and sharing of your performance and other data. By signing this form, you are not waiving any of your legal rights.

_____

Signature of Person Consenting and Authorizing Date

Authorization for _____ to participate in the study.

Relationship to child participating in the study: parent / legal guardian

Please indicate below if you would like to be notified of future research projects conducted by our research group:

_____ (initial & surname) Yes, I would like to be added to your research participation pool and be notified of research projects in which I might participate in the future.

Method of contact:

Phone number: _____

E-mail address: _____

Mailing address: _____

_____

_____

APPENDIX N

Parental Consent Form for TBI Control Group Participants

Informed Consent for you and your child to participate in research and authorization for collection, use, and disclosure of neuropsychological rehabilitation and cognitive performance, and other personal data

You are being asked to allow your child to take part in a research study. This form provides you with information about the study and seeks your permission for the collection, use and disclosure of your child's neuropsychological rehabilitation and cognitive performance data, as well as other information necessary for the study. The Principal Investigator (the person in charge of this research) or a representative of the Principal Investigator will also describe this study to you and answer all of your questions. Your child's participation is entirely voluntary. Before you decide whether or not to allow your child to take part, read the information below and ask questions about anything you do not understand. By allowing your child to participate in this study you will not be penalized or lose any benefits to which you would otherwise be entitled.

1. Name of Participant ("Study Subject" – the child)

---

2. Title of Research Study

Implementation of an Attention Training Program in Children with Traumatic Brain Injury in South Africa

3. Principal Investigator(s) and Telephone Number(s)

Leigh Schrieff, Ph.D.
Department of Psychology
University of Cape Town
021-650-3708

Tali Lanesman (Masters Student)
Department of Psychology
University of Cape Town
tali.lanesman@gmail.com

4. Source of Funding or Other Material Support

National Research Foundation and the University of Cape Town's University Research Committee

5. What is the purpose of this research study?

The purpose of this research is to investigate the effectiveness of the Pay Attention! program in rehabilitating attention in children who have sustained a traumatic brain injury. This research was undertaken because of a need for such services in South Africa.

6. What will be done if you take part in this research study?

Firstly, you and your child will be asked to come to the University of Cape Town so that we can carry out some neuropsychological assessments. We will administer a series of tests that will examine your child's strengths and weakness, particularly with regards to his/her attention in various tasks. You will also be required to complete some forms so that we have a better understanding of your child's performance at home and at school. The Principal Investigator will also request that your child's teacher completes similar forms, so that we have a holistic understanding of your child's functioning.

Children with TBI will be divided into 3 groups and matched to other children with TBI based on age, gender and injury severity. These 3 groups will be randomly allocated to the group that receives the intervention, a group that receives art classes, and a group that will not receive any intervention this year. Children with ADHD will then be matched to these 3 groups based on age and gender, and will receive the intervention under investigation.

After approximately 12 – 14 weeks, you and your child will again be requested to go to UCT for another neuropsychological assessment. Results obtained from these tests will be compared to the first tests.

Your child will not immediately receive the 12-week attention rehabilitation program that is under investigation. Should we find positive results for the attention-training program, then it will be made available to you on completion of the study. In order to reliably assess whether or not this program is successful, we will need to compare children who participate in the program to children who do not participate in it.

7. If you choose to participate in this study, how long will you be expected to participate in the research?

You will be asked to set aside approximately 3 hours for testing now, and another 3 hours in approximately 3 months time.

However, if at any time during the research period you feel that you do not wish to continue, you are free to discontinue your participation without penalty.

8. How many people are expected to participate in the research?

20 children and their parents/guardians/caregivers.

9. What are the possible discomforts and risks for you or your child?

There are no known risks associated with taking part in this study.

During the testing period we may find that your child may need assistance in other areas of functioning not covered by the current intervention. Should this happen, we will discuss this with you and give a referral for the necessary care. Children may also feel fatigued or irritable during testing as the tasks require concentration. However, children will be given breaks where necessary as well as refreshments. Where necessary, testing can be split over 2 days.

If you wish to discuss the information above or any discomforts you may experience, you may ask questions now or call the Principal Investigators listed on the front page of this form.

Please note that the University of Cape Town carries a No Fault Clinical Liability policy for participants who suffer a research-related injury in researcher-initiated clinical research: http://www.health.uct.ac.za/usr/health/research/hrec/forms/No_Fault_Insurance_2013.pdf

Please not that there are no risks in “delaying treatment” as this treatment would not be available to participants without this study, and in addition its efficacy on children with TBI is not yet definitive.

If you wish to discuss the information above or any discomforts you may experience, you may ask questions now or call the Principal Investigators listed on the front page of this form.

10. What are the possible benefits to you and your child?

The aim of this study is to investigate how effective the Pay Attention! intervention will be for children who have sustained traumatic brain injuries. However, it is not guaranteed that the intervention will result in improved attention. Should the Pay Attention! program prove to be efficacious, this program will be offered to you upon completion of the study.

Your child will also be receiving two neuropsychological test batteries which could help give you an understanding of their recovery and development since their injury.

11. What are the possible benefits to others?

Should this training program prove to be effective, this will be an important contribution to future neuropsychological rehabilitation services offered to other children who have sustained traumatic brain injuries. In other words, this research can then be applied to other children, or families of children, who have experienced a traumatic brain injury. It will also help to motivate the need for formal development of such services in South Africa.

12. If you choose to take part in this research study, will it cost you anything?

Participating in this study will not cost you anything financially.

13. Will you and your child receive compensation for taking part in this research study?

You will receive R50 for each assessment for both participation and transport. Refreshments will be available at each of the assessments.

14. Can you and your child withdraw from this research study?

You may withdraw your consent and to stop participating in this research study at any time, without any penalty to you or your child.

In addition, refusal to consent to participation in the study will not affect current or future health care.

If you have a complaint or complaints about your rights and welfare as research participants, please contact the Human Research Ethics Committee

Tel: 021 406 6492

E-mail: sumaya.ariefdien@uct.ac.za

15. If you withdraw, can information about you and your child still be used and/or collected?

Information that has already been collected may be used.

16. Once personal and performance information is collected, how will it be kept secret (confidential) in order to protect your privacy?

Information collected will be stored in locked filing cabinets or on computers with security passwords. Only the researcher and two supervisors will have access to this information. Your research records will not be released without your permission unless required by law or a court order.

However, the researcher is obliged to report cases in which deliberate abuse or neglect is evident.

17. What information about you or your child may be collected, used and shared with others?

This information gathered from you will be demographic information, records of your responses, or your child's performance on the neuropsychological tests, and records of your child's progress in the intervention. If you agree to be in this research study, it is possible that some of the information collected might be copied into a "limited data set" (a computer file) to be used for other research purposes. If so, the limited data set may only include information that does not directly identify you or your child. For example, the limited data set cannot include you or your child's name, address, telephone number, ID number, or any other photographs, numbers, codes, or so forth that link you to the information in the limited data set.

18. How will the researcher(s) benefit from your being in the study?

This study is being conducted as a partial fulfillment for a Masters degree at the University of Cape Town. In addition, the researcher may choose to present this research at a conference or in a scientific journal.

Signatures

As a representative of this study, I have explained to the participant's (child's) parent the purpose, the procedures, the possible benefits, and the risks of this research study; and how the participant's performance and other data will be collected, used, and shared with others:

_____

Signature of Person Obtaining Consent and Authorization Date

You have been informed about this study's purpose, procedures, possible benefits, and risks; and how your responses and your child's performance and other data will be collected, used and shared with others. You have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time.

You voluntarily agree for you and your child to participate in this study. You hereby authorize the collection, use and sharing of your performance and other data. By signing this form, you are not waiving any of your legal rights.

_____

Signature of Person Consenting and Authorizing Date

Authorization for _____ to participate in the study.
Relationship to child participating in the study: parent / legal guardian

_____

Please indicate below if you would like to be notified of future research projects conducted by our research group:

_____ (initial & surname) Yes, I would like to be added to your research participation pool and be notified of research projects in which I might participate in the future.

Method of contact:
Phone number: _____
E-mail address: _____
Mailing address: _____
_____

APPENDIX O

Teacher Consent Form for Study Participation

Informed Consent for you to participate in research and authorization for collection, use, and disclosure of neuropsychological rehabilitation and cognitive performance, and other personal data

You are being asked to take part in a research study. This form provides you with information about the study and seeks your permission for the collection, use and disclosure information necessary for the study. The Principal Investigator (the person in charge of this research) or a representative of the Principal Investigator will also describe this study to you and answer all of your questions. Your s participation is entirely voluntary. Before you decide whether or not to take part, read the information below and ask questions about anything you do not understand. By participating in this study you will not be penalized or lose any benefits to which you would otherwise be entitled.

1. Name of Participant

---

2. Title of Research Study

Implementation of an Attention Training Program in Children with Traumatic Brain Injury in South Africa

3. Principal Investigator(s) and Telephone Number(s)

Leigh Schrieff, Ph.D.	Tali Lanesman (Masters Student)
Department of Psychology	Department of Psychology
University of Cape Town	University of Cape Town
021-650-3708	tali.lanesman@gmail.com

4. Source of Funding or Other Material Support

National Research Foundation and the University of Cape Town's University Research Committee

5. What is the purpose of this research study?

The purpose of this research is to investigate the effectiveness of the Pay Attention! program in rehabilitating attention in children who have sustained a traumatic brain injury. This research was undertaken because of a need for such services in South Africa.

6. What will be done if you take part in this research study?

The principle investigator will arrange to meet with you at your school at a time that is convenient for you. You will be required to complete some forms so that we have a better understanding of your student's performance at school, so that we have a holistic understanding of your student's functioning.

Children who have sustained a TBI will be divided into 3 groups and matched to other children with TBI based on age, gender and injury severity. These 3 groups will then be randomly allocated to the group that receives the attention training intervention that is being evaluated, a group that receives art classes, and a group that will not receive any intervention this year. Children with ADHD will then be matched to these 3 groups based on age and gender, and will receive the intervention under investigation. You will not necessarily know which group your student has been allocated to.

After the intervention, a research assistant will make an appointment with you, and you will be asked to fill out some more forms regarding your student's functioning. Results obtained from these tests will be compared to the first tests.

7. If you choose to participate in this study, how long will you be expected to participate in the research?

You will be required to meet with a researcher twice, once in January/February, and again 12 – 14 weeks later.

8. How many people are expected to participate in the research?

20 children and their parents/guardians/caregivers/teachers

9. What are the possible discomforts and risks for you?

There are no known risks to you associated with taking part in this study.

10. What are the possible benefits to you and your student?

The aim of this rehabilitation program is to implement and evaluate an intervention focused on improving attention. As part of this aim is to investigate how effective this intervention might be, it is not guaranteed that the attention-training program will result in improved functioning or performance for your student. It is important to bear this in mind at the outset of the study. However, part of the neuropsychological rehabilitation service is to provide you, the teacher, with useful advice regarding the classroom management of your student in line with his / her areas of strengths and weaknesses.

By you and your student partaking in the neuropsychological assessment, this will provide you with a deeper understanding of the neuropsychological functioning of your student.

11. What are the possible benefits to others?

Should this training program prove to be effective, this will be an important contribution to future neuropsychological rehabilitation services offered to other children who have sustained traumatic brain injuries. In other words, this research can then be applied to other children, or families of children, who have experienced a traumatic brain injury. It will also help to motivate the need for formal development of such services in South Africa.

12. If you choose to take part in this research study, will it cost you anything?

Participating in this study will not cost you anything.

13. Will you and your student receive compensation for taking part in this research study?

You will receive compensation of R25 for each of the assessments.

14. Can you withdraw from this research study?

You may withdraw your consent and to stop participating in this research study at any time, without any penalty to you or your student.

In addition, refusal to consent to participation in the study will not affect current or future health care.

If you have a complaint or complaints about your rights and welfare as research participants, please contact the Human Research Ethics Committee

Tel: 021 406 6492
E-mail: sumaya.ariefdien@uct.ac.za

15. If you withdraw, can information about you and your student still be used and/or collected?

Information that has already been collected may be used.

16. Once personal and performance information is collected, how will it be kept secret (confidential) in order to protect your privacy?

Information collected will be stored in locked filing cabinets or on computers with security passwords. Only the researcher and two supervisors will have access to this information. Your research records will not be released without your permission unless required by law or a court order.

However, the researcher is obliged to report cases in which deliberate abuse or neglect is evident.

17. What information about you or your student may be collected, used and shared with others?

This information gathered from you will be records of your responses with regards to your student's functioning in the classroom. If you agree to be in this research study, it is possible that some of the information collected might be copied into a "limited data set" (a computer file) to be used for other research purposes. If so, the limited data set may only include information that does not directly identify you or your student. For example, the limited data set cannot include you or your student's name, address, telephone number, ID number, or any other photographs, numbers, codes, or so forth that link you to the information in the limited data set.

18. How will the researcher(s) benefit from your being in the study?

The information that you can provide with regards to your student's performance, is helpful in understanding the usefulness and success of the intervention program under investigation.

This study is being conducted as a partial fulfillment for a Masters degree at the UCT. In addition, the researcher may choose to present this research at a conference or in a scientific journal.

Signatures

As a representative of this study, I have explained to the participant's (child's) parent the purpose, the procedures, the possible benefits, and the risks of this research study; and how the participant's performance and other data will be collected, used, and shared with others:

_____

Signature of Person Obtaining Consent and Authorization Date

You have been informed about this study's purpose, procedures, possible benefits, and risks; and how your responses and your child's performance and other data will be collected, used and shared with others. You have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time.

You voluntarily agree for you and your child to participate in this study. You hereby authorize the collection, use and sharing of your performance and other data. By signing this form, you are not waiving any of your legal rights.

_____

Signature of Person Consenting and Authorizing Date

Authorization for _____ to participate in the study.

Relationship to child participating in the study: parent / legal guardian

_____

Please indicate below if you would like to be notified of future research projects conducted by our research group:

_____ (initial & surname) Yes, I would like to be added to your research participation pool and be notified of research projects in which I might participate in the future.

Method of contact:

Phone number: _____

E-mail address: _____

Mailing address: _____

_____

_____

APPENDIX P

Assent Form for TBI Intervention Group Participants

We would like you to be in our research study because we would like to learn more about children with head injuries and ways to help them.

If you agree to be in this study we will ask you to come to the University of Cape Town (UCT) to do some activities with us. For example, we may ask you to try to remember things, to draw or read things.

We will then ask you to come to the University of Cape Town twice a week for 12 weeks to do more activities with us. For example, we may ask you to sort out different colour cards or to press a clicker when you hear certain words on a CD.

These exercises and activities will not hurt you, but some of them may be long and you may feel tired at times. If you do, you can stop and take a break at any time.

After the 12 weeks, we will ask you to come to UCT one last time to do some different activities with us. Like before, we may ask you to try to remember things, to draw or read things.

Signing this paper means that you want to be in the study. If you don't want to be in the study, don't sign the paper. No one will be cross if you don't sign this paper, and no one will be cross if you change your mind later and want to stop.
You can ask any questions that you have about the study. If you have a question later that you didn't think of now, you can call me on 0828121224 or ask me next time.

Signature of Participant _____ Date _____
Signature of Investigator _____ Date _____

APPENDIX Q

Assent Form for ADHD Intervention Group Participants

We would like you to be in our research study because we would like to learn more about children who have difficulty paying attention and ways to help them.

If you agree to be in this study we will ask you to come to the University of Cape Town (UCT) to do some activities with us. For example, we may ask you to try to remember things, to draw or read things.

We will then ask you to come to the University of Cape Town twice a week for 12 weeks to do more activities with us. For example, we may ask you to sort out different colour cards or to press a clicker when you hear certain words on a CD.

These exercises and activities will not hurt you, but some of them may be long and you may feel tired at times. If you do, you can stop and take a break at any time.

After the 12 weeks, we will ask you to come to UCT one last time to do some different activities with us. Like before, we may ask you to try to remember things, to draw or read things.

Signing this paper means that you want to be in the study. If you don't want to be in the study, don't sign the paper. No one will be cross if you don't sign this paper, and no one will be cross if you change your mind later and want to stop.
You can ask any questions that you have about the study. If you have a question later that you didn't think of now, you can call me on 0828121224 or ask me next time.

Signature of Participant _____ Date _____
Signature of Investigator _____ Date _____

APPENDIX R

Assent Form for TBI Art Group Participants

We would like you to be in our research study because we would like to learn more about children with head injuries and ways to help them.

If you agree to be in this study we will ask you to come to the University of Cape Town **(**UCT**)** to do some activities with us. For example, we may ask you to try to remember things, to draw or read things.

We will then ask you to do some art activities twice a week for 12 weeks. You will be given different art supplies like paints and crayons, and you will be able to draw anything that you like.

These exercises and activities will not hurt you, but some of them may be long and you may feel tired at times. If you do, you can stop and take a break at any time.

After the 12 weeks, we will ask you to come to UCT one last time to do some different activities with us. Like before, we may ask you to try to remember things, to draw or read things.

Signing this paper means that you want to be in the study. If you don't want to be in the study, don't sign the paper. No one will be cross if you don't sign this paper, and no one will be cross if you change your mind later and want to stop.
You can ask any questions that you have about the study. If you have a question later that you didn't think of now, you can call me on 0828121224 or ask me next time.

Signature of Participant _____ Date _____
Signature of Investigator _____ Date _____

APPENDIX S

Assent Form for TBI Control Group Participants

We would like you to be in our research study because we would like to learn more about children with head injuries and ways to help them.

If you agree to be in this study we will ask you to come to the University of Cape Town (UCT**)** to do some activities with us. For example, we may ask you to try to remember things, to draw or read things.

These exercises and activities will not hurt you, but some of them may be long and you may feel tired at times. If you do, you can stop and take a break at any time.

After about 12 weeks, we will ask you to come to UCT one last time to do some different activities with us. Like before, we may ask you to try to remember things, to draw or read things.

Signing this paper means that you want to be in the study. If you don't want to be in the study, don't sign the paper. No one will be cross if you don't sign this paper, and no one will be cross if you change your mind later and want to stop.
You can ask any questions that you have about the study. If you have a question later that you didn't think of now, you can call me on 0828121224 or ask me next time.

Signature of Participant _____ Date _____
Signature of Investigator _____ Date _____

APPENDIX T

Table T1

Subtests Making up Neuropsychological Composites at Pre-test: Between-group Comparisons for TBI Intervention Group and Control Groups (N = 19)

	Groups												Test statistics		
	TBI Intervention Group (n = 5)			TBI Art Group (n = 4)			TBI Control Group (n = 5)			ADHD Intervention Group (n = 5)					
Composite variable	*n*	*M(SD*	*Range*	*n*	*M(SD)*	Range	n	*M(SD)*	*Range*	n	*M(SD)*	Range	*F/H*	*p*	*r*
Sustained attention (α = .70)															
Score	5	6.60 (1.14)	5-8	4	6.25 (1.71)	4-8	5	6.40 (3.13)	3-9	5	5.60 (1.14)	4-7	1.25 [a]	.764	.33
Numbers Forwards	5	5.80 (4.09)	3-13	4	6.00 (1.16)	5-7	5	7.80 (3.56)	3-11	5	9.00 (2.35)	7-12	4.23 [a]	.246	.16
Same World	5	6.60 (1.14)	5-8	4	2.75 (1.50)	1-4	4	3.00 (2.45)	1-6	5	5.80 (2.86)	2-10	3.78	.017*	.45
INN CT	5	5.60 (5.46)	1-12	4	4.25 (2.75)	1-7	5	5.00 (3.93)	1-10	5	7.40 (4.04)	1-12	.47	.708	.09
INN Combined SS	5	4.60 (3.36)	1-8	4	5.25 (5.06)	1-11	5	3.60 (2.79)	1-7	5	6.00 (3.67)	1-10	.37	.775	.07
Omissions	4	82.51 (43.26)	46.75-137.08	4	83.06 (19.92)	66.07-111.76	4	104.18 (51.31)	64.21-172.66	5	57.86 (8.54)	46.02-66.77	4.54[a]	.214	.24
Commissions	4	47.03 (6.63)	38.11-53.81	4	48.65 (8.30)	39.55-59.04	4	45.76 (9.35)	35.26-55.87	5	50.85 (16.13)	22.38-60.94	2.33[a]	.537	.02
Hit RT	4	77.86 (21.05)	50.72-99.17	4	77.31 (8.20)	66.14-85.30	4	85.05 (14.54)	66.24-98.81	5	67.06 (3.90)	61.85-71.45	4.53[a]	.216	.18
Hit RT SE	4	71.70 (17.99)	46.59-86.04	4	72.88 (7.22)	66.56-81.95	4	79.75 (9.99)	69.17-91.43	5	66.46 (7.43)	55.80-76.33	1.05	.408	.19
Hit RT ISI Change	4	65.73 (18.63)	42.56-83.74	4	71.96 (14.44)	57.21-91.29	4	81.99 (16.64)	60.88-99.57	5	67.86 (15.39)	54.09-93.80	.81	.513	.16

Hit SE ISI Change	4	56.63 (8.86)	45.66-64.06	4	60.75 (9.99)	47.84-71.74	4	63.96 (1.39)	62.40-65.58	5	59.12 (7.29)	48.90-67.69	.66	.593	.13
Variability	4	63.87 (14.30)	43.58-76.59	4	64.65 (7.67)	54.51-71.58	4	71.36 (5.74)	66.90-79.46	5	61.78 (8.68)	49.34-71.50	.80	.518	.16
Detectability	4	47.18 (10.19)	32.60-56.38	4	51.27 (12.17)	41.53-68.41	4	52.82 (11.91)	36.56-65.20	5	47.56 (16.92)	19.05-59.86	.18	.908	.04
Selective attention (α = .67)															
Sky Search targets found	5	10.80 (4.76)	3-16	4	8.75 (4.11)	4-14	5	8.00 (4.74)	2-14	5	10.20 (5.26)	3-16	.36	.785	.07
Sky Search time-per-target	5	4.00 (2.83)	1-7	4	2.50 (1.73)	1-5	5	2.80 (2.68)	1-7	5	6.20 (4.09)	1-10	3.10[a]	.397	.06
Sky Search attention score	5	7.40 (5.03)	1-14	4	2.75 (2.22)	1-6	5	4.20 (3.11)	1-8	5	7.00 (4.42)	1-12	1.46	.265	.23
Attentional control															
Opposite worlds	5	4.20 (3.03)	2-8	4	1.50 (1.00)	1-3	4	2.75 (2.06)	1-5	5	4.60 (3.36)	1-9	4.32[a]	.241	.16
Divided attention															
Sky Search DT	5	2.00 (2.24)	1-6	4	1.50 (1.00)	1-3	5	2.40 (3.13)	1-8	5	2.40 (3.13)	1-8	.02 [a]	1.000	.02
Inhibition (α = .93)															
INI Total CT	5	8.40 (5.23)	3-14	4	6.75 (4.27)	2-12	4	7.25 (4.35)	1-11	5	9.20 (3.11)	4-12	.30	.827	.06
INI Combined SS	5	6.00 (4.06)	1-10	4	3.25 (2.22)	1-6	4	5.75 (4.27)	1-11	5	8.00 (4.00)	2-13	4.53[a]	.219	.18
Working memory															
Numbers backwards	3	5.33 (1.53)	4-7	3	5.33 (3.06)	2-8	4	7.00 (3.27)	3-11	5	8.80 (2.59)	6-13	4.53[a]	.219	.20
Verbal memory (α = .91)															
WL Learning	5	4.80 (3.70)	1-10	4	2.25 (1.50)	1-4	5	4.00 (3.67)	1-8	5	7.20 (3.49)	3-12	4.69[a]	.199	.26

WL Delayed	5	7.80 (2.68)	6-12	4	4.75 (1.71)	3-7	5	8.00 (4.95)	4-16	5	8.40 (1.14)	7-10	5.49[a]	.135	.20
WL Delayed Recognition	5	5.80 (4.09)	3-13	4	3.25 (.50)	3-4	5	4.80 (4.60)	2-13	5	7.00 (4.64)	2-13	2.87[a]	.437	.04
Visual memory (α = .82)															
DL Learning	5	6.40 (1.67)	5-9	4	8.00 (2.94)	5-12	5	6.00 (3.24)	3-10	5	9.60 (2.97)	5-13	1.76	.197	.26
DL Long Delay	5	9.00 (1.41)	8-11	4	8.00 (3.92)	3-12	5	8.60 (2.19)	7-11	5	10.00 (5.24)	1-14	2.31	.537	.05
DL Total Score	5	6.80 (1.30)	6-9	4	8.75 (2.99)	6-13	5	6.60 (2.70)	4-10	5	10.80 (3.63)	5-15	5.07[a]	.166	.33

Note. [a]Kruskal Wallis H statistic. The *r* value here is an estimate of effect size. Composites were calculated using z-scores but domains with only one test (Attentional control, divided attention, working memory) were calculated using scaled scores. INN = Inhibition-Naming; CT = Completion Time; SS = Scaled Score; RT = Reaction Time; SE = Standard Error; ISI = Inter-stimulus Interval; DT = Dual Task; INI = Inhibition-Inhibition; WL = Word List; DL = Dot Locations. *p = <.05.

APPENDIX U

Table U1

Between-group Analyses for Neuropsychological Subtests at Pre-test: TBI Intervention Group vs. Control Groups (N = 19)

	Groups												Test statistics		
	TBI Intervention Group (*n* = 5)			TBI Art Group (*n* = 4)			TBI Control Group (*n* = 5)			ADHD Intervention Group (*n* = 5)					
	M(SD)	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*F/H*	*p*	*r*
Attention and Concentration															
Sky Search targets found	10.80 (4.76)	3-16		8.75 (4.11)	4-14		8.00 (4.74)	2-14		10.20 (5.26)	3-16		.36	.785	.07
Sky Search time-per-target	4.00 (2.83)	1-7	10.10	2.50 (1.73)	1-5	8.38	2.80 (2.68)	1-7	7.80	6.20 (4.09)	1-10	13.40	3.10[a]	.397	.06
Sky Search attention score	7.40 (5.03)	1-14		2.75 (2.22)	1-6		4.20 (3.11)	1-8		7.00 (4.42)	1-12		1.46	.265	.23
Score	6.60 (1.14)	5-8	11.00	6.25 (1.71)	4-8	10.13	6.40 (3.13)	3-9	11.20	5.60 (1.14)	4-7	7.70	1.25[a]	.764	.33
Sky Search DT	2.00 (2.24)	1-6	9.80	1.50 (1.00)	1-3	10.00	2.40 (3.13)	1-8	10.10	2.40 (3.13)	1-8	10.10	.02[a]	1.000	.02
Same World	6.60 (1.14)	5-8		2.75 (1.50)	1-4		3.00 (2.45)[b]	1-6		5.80 (2.86)	2-10		3.78	.017*	.45
Opposite World	4.20 (3.03)	2-8	11.60	1.50 (1.00)	1-3	5.38	2.75 (2.06)[b]	1-5	8.38	4.60 (3.36)	1-9	11.60	4.32[a]	.241	.16
Omissions	82.51 (43.26)[b]	46.75-137.08	8.50	83.06 (19.92)	66.07-111.76	11.50	104.18 (51.31)[b]	64.21-172.66	11.50	57.86 (8.54)	46.02-66.77	5.40	4.54[a]	.214	.24
Commissions	47.03 (6.63)[b]	38.11-53.81	7.38	48.65 (8.30)	39.55-59.04	8.63	45.76 (9.35)[b]	35.26-55.87	7.50	50.85 (16.13)	22.38-60.94	11.80	2.33[a]	.537	.02
Hit RT	77.86 (21.05)[b]	50.72-99.17	10.25	77.31 (8.20)	66.14-85.30	9.50	85.05 (14.54)[b]	66.24-98.81	12.00	67.06 (3.90)	61.85-71.45	5.20	4.53[a]	.216	.18
Hit RT SE	71.70 (17.99)[b]	46.59-86.04		72.88 (7.22)	66.56-81.95		79.75 (9.99)[b]	69.17-91.43		66.46 (7.43)	55.80-76.33		1.05	.408	.19

Variability	63.87 (14.30)[b]	43.58-76.59		64.65 (7.67)	54.51-71.58		71.36 (5.74)[b]	66.90-79.46		61.78 (8.68)	49.34-71.50		.80	.518	.16
Detectability	47.18 (10.19)[b]	32.60-56.38		51.27 (12.17)	41.53-68.41		52.82 (11.91)[b]	36.56-65.20		47.56 (16.92)	19.05-59.86		.18	.908	.04
Perseverations	120.61 (66.99)[b]	54.24-200.68	11.25	63.06 (12.84)	54.00-82.01	6.50	69.87 (17.30)[b]	55.61-94.72	8.50	91.26 (48.87)	49.67-172.10	9.60	1.88[a]	.630	.08
Hit RT Block Change	47.29 (12.15[b]	31.34-60.85		38.85 (16.46)	16.50-52.75		44.71 (21.73)[b]	13.68-60.45		59.14 (12.72)	41.16-75.16		1.31	.314	.23
Hit SE Block Change	51.75 (8.98)[b]	41.57-63.37		50.23 (15.74)	32.61-70.91		46.75 (14.95)[b]	25.45-60.01		54.60 (7.20)	47.50-65.22		.33	.804	.07
Hit RT ISI Change	65.73 (18.63)[b]	42.56-83.74		71.96 (14.44)	57.21-91.29		81.99 (16.64)[b]	60.88-99.57		67.86 (15.39)	54.09-93.80		.83	.513	.16
Hit SE ISI Change	56.63 (8.86)[b]	45.66-64.06		60.75 (9.99)	47.84-71.74		63.96 (1.39)[b]	62.40-65.58		59.12 (7.29)	48.90-67.69		.66	.593	.13
Confidence index	76.03 (28.28)[b]	44.39-99.90	8.75	84.94 (10.11)	78.21-99.90	11.25	88.40 (13.28)[b]	76.85-99.90	10.75	68.94 (14.21)	49.73-81.50	6.00	3.13[a]	.394	.20
Number Forwards	5.80 (4.09)	3-13	6.80	6.00 (1.16)	5-7	8.50	7.80 (3.56)	3-11	10.70	9.00 (2.35)	7-12	13.70	4.23[a]	.246	.06
Numbers Backwards	5.33 (1.53)[c]	4-7	5.00	5.33 (3.06)[c]	2-8	5.83	7.00 (3.27)	3-11	8.00	8.80 (2.59)	6-13	11.10	4.53[a]	.219	.20
Numbers Total	6.00 (3.46)[c]	4-10	6.33	4.33 (1.53)[c]	3-6	4.00	7.25 (2.63)[b]	5-10	9.00	8.60 (3.05)	5-13	10.60	4.81[a]	.191	.22
INN Total CT	5.60 (5.46)	1-12		4.25 (2.75)	1-7		5.00 (3.93)	1-10		7.40 (4.04)	1-12		.47	.708	.09
INN Combined SS	4.60 (3.36)	1-8		5.25 (5.06)	1-11		3.60 (2.79)	1-7		6.00 (3.67)	1-10		.37	.775	.07
INI Total CT	8.40 (5.23)	3-14		6.75 (4.27)	2-12		7.25 (4.35)	1-11		9.20 (3.11)	4-12		.30	.827	.06
INI Combined SS	6.00 (4.06)	1-10		3.25 (2.22)	1-6		5.75 (4.27)[b]	1-11		8.00 (4.00)	2-13		1.18	.354	.20
INN vs. INI Contrast SS	7.60 (3.44)	3-11		4.25 (2.75)	1-7		7.75 (5.25)[b]	3-15		9.40 (3.65)	5-14		1.37	.293	.23

Inhibition Total Errors	5.20 (3.90)	1-9	6.70	MD [d]	MD	5.00	3.00 (3.00) [c]	0-6	3.67	8.50 (1.29) [b]	7-10	10.38	5.56[a]	.106	.35
Memory															
DL Learning	6.40 (1.67)	5-9		8.00 (2.94)	5-12		6.00 (3.24)	3-10		9.60 (2.97)	5-13		1.76	.197	.26
DL Short Delay	7.80 (1.79)	5-10	7.50	9.75 (2.50)	7-13	10.50	8.20 (1.64)	7-10	7.40	12.40 (3.05)	7-14	14.70	5.77[a]	.118	.45
DL Long Delay	9.00 (1.41)	8-11	9.80	8.00 (3.92)	3-12	8.50	8.60 (2.19)	7-11	8.30	10.00 (5.24)	1-14	13.10	2.31[a]	.537	.05
DL Total Score	6.80 (1.30)	6-9	8.20	8.75 (2.99)	6-13	11.38	6.60 (2.70)	4-10	6.70	10.80 (3.63)	5-15	14.00	5.07[a]	.166	.33
WL Learning	4.80 (3.70)	1-10	10.30	2.25 (1.50)	1-4	6.25	4.00 (3.67)	1-8	8.70	7.20 (3.49)	3-12	14.00	4.69[a]	.199	.26
WL Delayed	7.80 (2.68)	6-12	10.80	4.75 (1.71)	3-7	4.75	8.00 (4.95)	4-16	10.00	8.40 (1.14)	7-10	13.40	5.49[a]	.135	.20
WL Delayed Recognition	5.80 (4.09)	3-13	12.50	3.25 (.50)	3-4	7.88	4.80 (4.60)	2-13	7.80	7.00 (4.64)	2-13	11.40	2.87[a]	.437	.04

Note. [a]Kruskal Wallis H statistic. [b] $n = 4$. [c] $n = 3$ [d] $n = 1$. The r value here is an estimate of effect size. INN = Inhibition-Naming; CT = Completion Time; SS = Scaled Score; RT = Reaction Time; SE = Standard Error; ISI = Inter-stimulus Interval; DT = Dual Task; INI = Inhibition-Inhibition; MD = Missing Data; WL = Word List; DL = Dot Locations.

APPENDIX V

Table V1

Between-group Analyses for BRIEF Parent Report at Pre-test: TBI Intervention Group vs. Control Groups (N = 19)

	Groups								Test statistics		
	TBI Intervention Group (*n* = 5)		TBI Art Group (*n* = 4)		TBI Control Group (*n* = 5)		ADHD Intervention Group (*n* = 5)				
BRIEF index	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*F/H*	*p*	*r*
Inhibit	59.00 (14.11)	40-76	60.25 (19.70)	40-80	59.00 (19.61)	38-83	63.80 (19.61)	53-78	.10	.960	.02
Shift	55.80 (12.93)	43-77	66.50 (12.56)	56-81	54.20 (9.58)	41-64	69.40 (5.55)	64-77	2.57	.093	.34
Emotional Control	61.80 (11.69)	49-80	59.75 (13.67)	40-71	59.40 (16.47)	41-80	65.20 (4.87)	58-71	.23	.878	.04
BRI	60.60 (13.96)	43-82	63.50 (15.29)	44-81	59.00 (17.88)	39-81	68.00 (6.63)	61-78	.40	.757	.07
Initiate	52.20 (10.13)	42-65	64.75 (19.89)	36-81	57.00 (19.61)	39-87	62.20 (9.37)	51-75	.62	.612	.11
Working memory	62.80 (12.17)	53-83	60.75 (17.54)	41-80	56.40 (18.02)	36-78	63.00 (9.14)	53-73	.22	.878	.04
Plan/organisation	60.60 (17.30)	43-81	62.00 (14.77)	44-78	51.60 (9.86)	41-67	58.00 (13.29)	44-78	.51	.680	.09
Org. of materials	53.60 (13.61)	33-70	60.75 (15.97)	37-71	50.20 (15.72)	32-73	58.80 (7.79)	52-71	1.64 [a]	.651 [b]	.09
Monitor	56.80 (15.90)	38-70	62.25 (15.63)	46-78	50.60 (14.26)	35-73	60.40 (11.41)	50-76	.60	.623	.11
MI	58.80 (13.93)	43-75	69.25 (11.00)	58-81	52.20 (17.44)	33-72	62.00 (10.17)	52-77	1.22	.338	.20
GEC	60.40 (14.31)	43-80	65.75 (17.33)	42-83	55.60 (18.53)	35-78	65.40 (8.08)	58-79	.49	.695	.09

Note. [a]Kruskal Wallis H statistic; For Org. of materials, mean rank for TBI Intervention Group = 9.20, TBI Art Group = 12.25, TBI Control Group = 7.90, and ADHD Intervention Group = 11.10. [b]Exact level of significance not given, only asymptotic. The *r* value here is an estimate of effect size. BRIEF = Behaviour Rating Inventory of Executive Function. BRI = Behaviour Recognition Index, Org. = Organization, MI = Metacognition Index, GEC = Global Executive Composite.

APPENDIX W

Table W1

Between-group Analyses for BRIEF Teacher report at Pre-test: TBI Intervention Group vs. Control Groups (N = 17)

	Groups												Test statistics		
	TBI Intervention Group (*n* = 3)			TBI Art Group (*n* = 4)			TBI Control Group (*n* = 4)			ADHD Intervention Group (*n* = 5)					
BRIEF index	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*F/H*	*p*	*r*
Inhibit	52.33 (11.15)	44-65		53.50 (6.66)	48-63		56.80 (8.53)	46-69		61.00 (15.13)			.52	.677	.11
Shift	59.00 (12.29)	50-73		56.00 (10.20)	46-70		63.20 (19.6)	43-92		69.90 (22.84)	43-105		.47	.709	.10
Emotional Control	51.00 (12.17)	43-65	5.67	49.75 (8.92)	44-63	5.63	61.20 (12.54)	44.75	10.20	71.00 (19.93)	54-99	12.50	5.81[a]	.115	.29
BRI	54.33 (12.74)	46-69		53.25 (8.62)	47-66		61.00 (14.20)	44-81		70.60 (16.91)	54-98		1.45	.274	.25
Initiate	71.67 (14.05)	57-85	13.33	57.50 (9.71)	52-72	7.13	57.80 (12.56)	45-72	7.30	63.20 (9.34)	51-75	9.60	3.42[a]	.352	.09
Working memory	72.00 (17.35)	52-83		54.75 (9.00)	48-68		58.60 (11.61)	42-71		69.40 (7.40)	61-81		2.21	.136	.34
Plan/organisation	64.00 (11.53)	52-75	9.83	59.00 (14.00)	52-80	7.38	58.60 (14.22)	44-75	7.50	67.60 (10.29)	58-85	11.30	2.00[a]	.603	.06
Org. of materials	48.67 (8.08)	44-58	6.67	49.25 (10.05)	42-64	7.13	49.60 (8.33)	44-64	8.30	60.60 (12.30)	47-80	12.60	3.96[a]	.280	.14
Monitor	61.67 (9.07)	52-70		57.50 (6.95)	51-67		55.60 (8.96)	44-66		60.80 (13.35)	49-83		.33	.804	.07
MI	65.00 (11.36)	52-73	11.00	56.00 (10.68)	50-72	6.50	61.00 (14.21)	44-76	8.60	66.20 (10.23)	59-84	10.20	1.77[a]	.654	.10
GEC	61.33 (12.01)	49-73	9.17	55.25 (10.53)	49-71	7.00	58.80 (13.65)	43-77	7.80	69.60 (13.24)	58-92	11.70	2.36[a]	.532	.02

Note. [a]Kruskal Wallis H statistic. The *r* value here is an estimate of effect size. BRIEF = Behaviour Rating Inventory of Executive Function. BRI = Behaviour Recognition Index, Org. = Organization, MI = Metacognition Index, GEC = Global Executive Composite.

APPENDIX X

Table X1

Between-group Analyses for VABS-II Parent Report at Pre-test: TBI Intervention Group vs. Control Groups (N =19)

	Groups								Test statistics		
	TBI Intervention Group (n = 5)		TBI Art Group (n = 4)		TBI Control Group (n = 5)		ADHD Intervention Group (n = 5)				
VABS-II	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*F/H*	*p*	*r*
Communication	35.80 (8.47)	29-50	36.75 (9.43)	25-48	39.00 (8.43)	28-50	42.00 (9.03)	31-55	.48	.702	.09
Receptive	11.80 (4.92)	8-20	11.75 (3.59)	9-17	12.40 (4.10)	8-19	12.40 (1.14)	11-14	.04	.987	.01
Expressive	13.80 (3.27)	10-19	12.25 (2.50)	9-15	12.00 (3.81)	8-18	16.20 (4.82)	10-23	1.27	.319	.20
Written	10.20 (1.92)	7-12	12.50 (4.04)	7-16	14.60 (6.73)	7-22	13.60 (4.22)	9-20	2.22 [a]	.556	.03
Daily Living Skills	39.00 (5.48)	34-48	37.25 (7.27)	27-44	44.00 (9.49)	33-59	43.60 (15.45)	30-70	.49	.698	.09
Personal	12.80 (2.59)	10-16	11.50 (2.89)	8-15	17.60 (4.67)	13-24	15.00 (4.95)	10-23	2.10	.144	.30
Domestic	13.00 (2.45)	10-16	13.50 (2.65)	10-16	12.80 (1.10)	11-14	15.40 (4.34)	12-23	1.84 [a]	.634	.08
Community	13.20 (2.17)	11-16	12.25 (3.40)	9-17	13.60 (6.35)	8-24	15.20 (5.26)	11-24	.32	.810	.06
Socialization	44.00 (14.44)	26-64	31.75 (10.91)	20-46	39.60 (9.76)	31-54	45.40 (8.08)	37-58	1.34	.299	.21
Interpersonal relationships	15.20 (5.50)	8-21	9.50 (4.80)	5-16	12.00 (4.53)	8-19	15.40 (2.3)	13-19	1.81	.188	.27
Play and leisure time	11.80 (5.07)	6-19	9.75 (4.03)	5-14	10.20 (2.17)	8-13	14.00 (4.36)	10-21	1.06	.394	.18
Coping skills	17.00 (4.69)	12-24	12.50 (3.79)	10-18	17.40 (5.68)	9-23	16.00 (1.58)	14-18	1.18	.352	.19
Adaptive behaviour composite	67.80 (11.37)	56-85	80.25 (15.59)	62-100	90.60 (12.78)	79-112	75.20 (29.53)	29-98	1.27	.319	.20

Note. [a]Kruskal Wallis H statistic; for Written, mean rank for TBI Intervention Group = 6.90, TBI Art Group = 10.25, TBI Control Group = 11.60, and ADHD Intervention Group = 11.30; for Domestic, mean rank for TBI Intervention Group = 9.50, TBI Art Group = 10.63, TBI Control Group = 7.70, and ADHD Intervention Group = 12.30. The *r* value here is an estimate of effect size.

APPENDIX Y

Table Y1

Between-group Analyses for CBCL Teacher Report at Pre-test: TBI Intervention Group vs. Control Groups (N =17)

CBCL syndrome profile	Groups												Test statistics		
	TBI Intervention Group (*n* = 3)			TBI Art Group (*n* = 4)			TBI Control Group (*n* = 4)			ADHD Intervention Group (*n* = 5)					
	M(SD)	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*F/H*	*p*	*r*
Anxious/depressed	54.00 (6.08)	50-61		61.75 (8.73)	50-71		66.20 (9.86)	50-74		64.20 (7.86)	53-73		1.39	.289	.24
Withdrawn/depressed	59.00 (7.21)	53-67		62.25 (5.73)	50-69		64.00 (11.64)	50-81		56.80 (5.54)	50-64		.65	.645	.13
Somatic complaints	55.33 (4.62)	50-58	6.83	64.25 (6.70)	57-73	12.00	63.80 (8.41)	50-71	11.90	52.40 (5.37)	50-62	5.00	7.10[a]	.054	.39
Attention problems	60.00 (9.00)	51-69	9.50	57.00 (6.22)	50-64	7.63	57.60 (5.13)	50-62	7.90	62.40 (7.77)	54 - 75	10.90	1.29 [a]	.760	.17
Rule-breaking behaviour	56.33 (8.51)	50-66	8.17	58.75 (7.54)	50-66	9.50	60.80 (8.59)	50-70	11.50	54.20 (7.82)	50-68	6.60	2.59[a]	.489	.01
Aggressive behaviour	57.33 (12.70)	50-72	7.33	60.75 (7.63)	50-68	8.50	62.00 (6.78)	50-66	9.70	62.20 (6.54)	53-69	9.70	.57[a]	.918	.34
Internalizing problems	55.00 (11.14)	45-67		64.00 (11.66)	48-76		65.20 (16.30)	37-78		60.80 (7.53)	52-70		.49	.694	.10
Externalizing behaviour	53.33 (15.70)	41-71		58.75 (12.18)	41-68		60.80 (10.47)	43-69		61.20 (6.65)	53-69		.38	.768	.08
ADHD problems	58.67 (8.08)	50-66		57.25 (5.74)	50-64		58.60 (5.64)	50-64		66.20 (12.28)	55-87		1.05	.403	.20

Note. [a]Kruskal Wallis H statistic. CBCL = Child Behaviour Checklist. ADHD = Attention Deficit Hyperactive Disorder. The *r* value here is an estimate of effect size.

APPENDIX Z

Table Z1

Neuropsychological Composites: Within-group Comparisons for TBI Intervention Group and Control Groups from Pre- to Post-intervention (N = 19)

	TBI Intervention Group (*n* = 5)		TBI Art Group (*n* = 4)		TBI Control Group (*n* = 5)		ADHD Intervention Group (*n* = 5)	
	Range	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*
Sustained attention								
Pre-intervention	-.39-.34[a]	.00(32)	-.28-.50	-.07 (.38)	-.04-.26[b]	.13 (.16)	-.66-.31	-.08 (.39)
Post-intervention	-.17-.36	.08 (.25)	-.50-.68	.02 (.52)	-.31-.26[a]	-.04 (.28)	46.28-62.89	-.03 (.43)
Z	.000		-.365		-1.604		-.135	
p	.563		.438		.125		.500	
Selective attention								
Pre-intervention	-1.16 - .86	.26 (.83)	-1.08-.12	-.43 (.53)	-1.23-.86	-.33(.83)	.34-1.41	.42 (.75)
Post-intervention	-1.22-1.19	.00 (1.09)	-1.06-.04	-.42 (.45)	-.48-.93[a]	.04 (.66)	.26-1.92	.37 (.90)
Z	-.405		-.365		.000		-.135	
p	.406		.438		.563		.500	
Attentional control								
Pre-intervention	2-8	4.20 (3.03)	1-3	1.50 (1.00)	1-5[a]	2.75 (2.06)	1-9	4.60 (3.36)
Post-intervention	2-12	4.40 (4.34)	1-6	3.25 (2.63)	1-8	4.60 (3.36)	1-11	5.80 (3.83)
Z	-.447		-1.342		-1.633		-1.86	
p	.500		.250		.125		.063	
Divided attention								
Pre-intervention	1-6	2.00 (2.24)	1-3	1.50 (1.00)	1-8	2.40 (3.13)	1-8	2.40 (3.13)
Post-intervention	1-4	1.60 (1.34)	1-10	4.25 (4.27)	1-5[a]	2.00 (2.00)	1-6	2.00 (2.24)
Z	-1.000		-1.342		-.447		-1.00	
p	.500		.250		.500		.500	

Inhibition								
	Pre-intervention	-1.26-1.28	.06 (1.16)	-1.38-.51	-5.00 (.82)	-1.51-1.04	-11 (1.07)	-1.00-1.30	.42 (.88)
	Post-intervention	-1.26-.52	-.31 (.79)	-1.26-.25	-.38 (.69)	-1.26-1.05	.04 (1.09)	-1.00-1.74	.56 (1.01)
	Z	-1.483		-.365		-1.095		-.674	
	p	.094		.438		.188		.313	
Working memory									
	Pre-intervention	4-7[b]	5.33 (1.52)	2-8[b]	5.33 (3.06)	3-11[b]	7.00 (3.27)	6-13	8.80 (2.59)
	Post-intervention	4-9[a]	7.25 (2.22)	7-8	7.50 (.58)	2-13	8.00 (4.30)	5-16	10.40 (4.45)
	Z	-1.604		-1.342		-1.826		-.730	
	p	.125		.250		.063		.313	
Verbal memory									
	Pre-intervention	-.61-1.66	.10 (.96)	-1.01- -.22	-.69 (.33)	-.99-1.89	-.04 (1.19)	-.48-1.63	.49 (.83)
	Post-intervention	-.75-.03	-.45 (.30)	-.66- - .21	-.46 (.20)	-1.30-1.34	-.19 (1.08)	.78-1.82[a]	1.26 (.51)
	Z	-1.214		-.730		-.674		-1.826	
	p	.156		.313		.313		.063	
Visual memory									
	Pre-intervention	-.62 -.47	-.27 (.44)	-.72-1.34	.02 (.94)	-1.16-.69	-.38 (.88)	-.52-1.67	.63 (.99)
	Post-intervention	-1.53-.82	-.69 (.99)	-.63 -.94	.11 (.67)	-1.79-.94	-.05 (1.09)	.11-1.19	.81 (.48)
	Z	-1.214		-.365		-.674		-.365	
	p	.156		.438		.313		.438	

Note. [a]*n* = 4. [b]*n* = 3.

APPENDIX AA

Table AA1

BRIEF Parent Behavioural measures: Within-group Comparisons for TBI Intervention Group and Control Groups from Pre- to Post-intervention (N = 19)

		TBI Intervention Group (*n* = 5)		TBI Art Group (*n* = 4)		TBI Control Group (*n* = 5)		ADHD Intervention Group (*n* = 5)	
		Range	M(SD)	Range	M(SD)	Range	M(SD)	Range	M(SD)
Inhibit	Pre-intervention	40-76	59.00 (14.11)	40-80	50.25 (19.70)	38-83	59.00 (19.61)	53-78	63.80 (10.62)
	Post-intervention	36-75	51.20 (15.77)	40-57	47.25 (7.14)	40-71	55.60 (14.86)	49-73	62.60 (11.61)
	Z		-1.095		-1.095		-.944		-.677
	p		.188		.188		.219		.281
Shift	Pre-intervention	43-77	55.80 (12.93)	56-81	66.50 (12.56)	41-64	54.20 (9.58)	64-77	69.40 (5.55)
	Post-intervention	37-60	50.80 (9.68)	43-56	49.75 (5.32)	39-74	57.40 (14.78)	47-84	64.40 (13.74)
	Z		-.944		-1.604		-.552		-.813
	p		.219		.125		.375		.250
Emotional control	Pre-intervention	49-80	61.80 (11.69)	40-71	59.75 (13.67)	41-80	59.40 (16.47)	58-71	65.20 (4.87)
	Post-intervention	40-61	50.00 (9.51)	45-78	59.25 (14.32)	36-67	53.40 (11.37)	43-73	62.80 (13.65)
	Z		-1.826		.000		-.944		-.135
	p		.063		.563		.219		.500

Initiate	Pre-intervention	42-65	52.20 (10.13)		36-81	64.75 (19.89)		39-87	57.00 (19.61)		51-75	62.20 (9.37)	
	Post-intervention	46-65	55.40 (7.16)		46-59	51.50 (6.56)		35-59	46.80 (9.42)		39-68	55.60 (11.15)	
	Z		-.365			-1.095			-.647			-1.841	
	p		.438			.188			.313			.063	
Working memory	Pre-intervention	53-83	62.80 (12.17)		41-80	60.75 (17.54)		36-78	56.40 (18.02)		53-73	63.00 (9.14)	
	Post-intervention	50-73	60.80 (9.73)		48-65	56.25 (7.37)		39-72	53.40 (14.98)		55-65	60.20 (4.82)	
	Z		-.365			.000			-.405			-.542	
	p		.438			.563			.406			.344	
Plan	Pre-intervention	43-81	60.60 (17.30)		44-78	62.00 (14.77)		41-67	51.60 (9.86)		44-78	58.00 (13.29)	
	Post-intervention	43-74	59.00 (11.47)		52-55	53.50 (1.29)		38-58	48.60 (7.93)		46-76	57.80 (11.88)	
	Z		-.271			-1.095			-.944			-.135	
	p		.438			.188			.219			.500	
Org. of materials	Pre-intervention	33-70	53.60 (13.61)		37-71	60.75 (15.97)		32-73	50.20 (15.72)		52-72	58.80 (7.79)	
	Post-intervention	40-63	51.60 (8.91)		43-57	50.50 (7.05)		34-61	46.20 (9.94)		46-72	58.60 (9.84)	
	Z		-.542			-1.461			-.674			-.184	
	p		.344			.125			.313			.500	
Monitor	Pre-intervention	38-70	56.80 (15.90)		46-78	62.25 (15.63)		35-73	50.60 (14.26)		50-76	60.40 (11.42)	
	Post-intervention	44-62	52.20 (7.33)		44-49	45.75 (2.36)							
	Z		-.813			-1.604			-.365			-.677	
	p		.250			.125			.438			.313	

BRI	Pre-intervention	43-82	60.60 (13.98)	44-81	63.50 (15.29)	39-81	59.00 (17.88)	61-78	68.00 (6.63)
	Post-intervention	35-66	50.40 (13.28)	44-52	46.50 (3.70)	36-72	55.80 (14.81)	44-75	64.60 (12.05)
	Z		-1.214		-1.461		-.944		-.271
	p		.156		.125		.219		.438
MI	Pre-intervention	43-75	58.80 (13.94)	58-81	69.25 (11.00)	33-72	52.20 (17.44)	52-77	62.00 (10.17)
	Post-intervention	44-70	57.00 (9.93)	48-56	52.00 (3.65)	35-65	48.60 (12.74)	50-75	59.80 (9.99)
	Z		-.730		-1.826		-.135		-.944
	p		.313		.063		.500		.219
GEC	Pre-intervention	43-80	60.40 (14.31)	42-83	65.75 (17.33)	35-78	55.60 (18.53)	58-79	65.40 (8.08)
	Post-intervention	40-70	55.00 (11.87)	47-55	50.25 (3.59)	35-69	51.80 (14.20)	52-75	62.40 (9.37)
	Z		-.406		-1.461		-.365		-.948
	p		.375		.125		.438		.188

Note. [a]Kruskal Wallis H statistic. BRIEF = Behaviour Rating Inventory of Executive Function. BRI = Behaviour Recognition Index, Org. = Organization, MI = Metacognition Index, GEC = Global Executive Composite.

APPENDIX BB

Table BB1

BRIEF Teacher Behavioural measures: Within-group Comparisons for TBI Intervention Group and Control Groups from Pre- to Post-intervention (N = 19)

		TBI Intervention Group (*n* = 3)		TBI Art Group (*n* = 4)		TBI Control Group (*n* = 4)		ADHD Intervention Group (*n* = 5)	
		Range	M(SD)	Range	M(SD)	Range	M(SD)	Range	M(SD)
Inhibit	Pre-intervention	44-65	52.33 (11.15)	48-63	53.50 (6.66)	46-69	56.80 (8.53)	44-78	61.00 (15.13)
	Post-intervention	44-66	53.00 (11.53)	43-57	49.33 (7.10)	56-69	62.20 (4.76)	43-71	55.60 (12.34)
	Z	-1.414		-.447		-1.069		-.962	
	p	.250		.500		.250		.250	
Shift	Pre-intervention	50-73	59.00 (12.29)	46-70	56.00 (10.20)	43-92	63.20 (19.69)	43-105	69.60 (22.84)
	Post-intervention	50-81	63.33 (15.95)	44-59	52.00 (7.55)	43-89	60.40 (17.86)	51-83	64.20 (12.62)
	Z	-1.342		.000		-1.342		-.405	
	p	.250		.625		.250		.406	
Emotional control	Pre-intervention	43-65	51.00 (12.17)	44-63	49.75 (8.92)	44-75	61.20 (12.54)	54-99	71.00 (16.93)
	Post-intervention	45-71	55.00 (14.00)	43-50	45.67 (3.79)	44-84	59.40 (14.44)	48-73	55.40 (10.02)
	Z	-1.414		-.447		.000		-1.483	
	p	.250		.500		.563		.094	

Initiate	Pre-intervention	57-85	71.67 (14.05)			52-72	57.50 (9.71)			45-72	57.80 (12.56)			51-75	63.20 (9.34)
	Post-intervention	59-85	76.33 (15.01)			46-62	54.33 (8.02)			44-72	56.80 (10.71)			46-69	61.80 (9.26)
	Z		-1.342				-.535				-.365				-.405
	p		.250				.375				.438				.406
Working memory	Pre-intervention	52-83	72.00 (17.35)			48-68	54.75 (9.00)			42-71	58.60 (11.61)			61-81	69.40 (7.40)
	Post-intervention	59-85	74.00 (13.45)			42-59	51.33 (8.62)			47-73	57.20 (10.21)			63-71	67.60 (3.13)
	Z		-.535				.535				-.406				-.271
	p		.375				.375				.375				.438
Plan	Pre-intervention	52-75	64.00 (11.53)			52-80	59.00 (14.00)			44-75	58.60 (14.22)			58-85	67.60 (10.29)
	Post-intervention	57-87	74.33 (15.54)			42-61	53.00 (9.85)			42-70	57.40 (10.21)			57-73	66.40 (6.19)
	Z		-1.604				.000				-.365				-.405
	p		.125				.625				.438				.406
Org. of materials	Pre-intervention	44-58	48.67 (8.08)			42-64	49.25 (10.05)			44-64	49.60 (8.33)			47-80	60.60 (12.30)
	Post-intervention	44-69	53.33 (13.65)			42-50	46.33 (4.04)			42-69	55.60 (10.97)			44-78	58.60 (13.33)
	Z		-1.342				-1.414				-1.414				-1.236
	p		.250				.250				.156				.156
Monitor	Pre-intervention	52-70	61.67 (9.07)			51-67	57.70 (6.95)			44-66	55.60 (8.96)			49-83	60.80 (13.35)
	Post-intervention	52.78	62.00 (14.00)			40-66	52.33 (13.05)			56-76	62.60 (7.77)			49-76	63.20 (11.93)
	Z		-.447				-.535				-1.473				-.730
	p		.500				.375				.125				.313

BRI	Pre-intervention	46-69	54.33 (12.74)	47-66	53.25 (8.62)	44-81	61.00 (14.20)	54-98	70.60 (16.91)
	Post-intervention	46-74	57.33 (14.74)	42-54	48.67 (6.11)	55-80	62.00 (10.20)	48-76	59.20 (10.83)
	Z		-1.342		-.447		-.135		-.730
	p		.250		.500		.500		.094
MI	Pre-intervention	52-73	65.00 (11.36)	50-72	56.00 (10.68)	44-76	61.00 (14.21)	59-84	66.20 (10.23)
	Post-intervention	55-85	70.33 (15.011)	41-60	51.33 (9.61)	49-74	58.80	54-74	65.60 (8.20)
	Z		-1.604		-.272		-.135		-.135
	p		.125		.500		.500		.500
GEC	Pre-intervention	49-73	61.33 (12.01)	49-71	55.25 (10.53)	43-77	58.80 (13.65)	58-92	69.60 (13.24)
	Post-intervention	65-83	73.33 (9.07)	41-58	50.33 (8.62)	53-89	63.80 (14.55)	52-72	64.20 (8.73)
	Z		-1.604		-.272		-.944		-.730
	p		.125		.500		.219		.313

Note. [a]Kruskal Wallis H statistic. BRIEF = Behaviour Rating Inventory of Executive Function. BRI = Behaviour Recognition Index, Org. = Organization, MI = Metacognition Index, GEC = Global Executive Composite.

APPENDIX CC

Table CC1

CBCL Teachers Behavioural Measures: Within-group Comparisons for TBI Intervention Group and Control Groups from Pre- to Post-intervention (N = 19)

		TBI Intervention Group (*n* = 3)		TBI Art Group (*n* = 4)		TBI Control Group (*n* = 4)		ADHD Intervention Group (*n* = 5)	
		Range	M(SD)	Range	M(SD)	Range	M(SD)	Range	M(SD)
Anxious/depressed	Pre-intervention	50-61	54.00 (6.08)	50-71	61.75 (8.73)	50-74	66.20 (9.86)	53-73	64.20 (7.86)
	Post-intervention	50-81	62.00 (16.64)	50-62	54.00 (6.93)	50-66	58.80 (7.40)	50-68	60.00 (6.75)
	Z		-1.342		-1.000		-1.826		-1.214
	p		.250		.500		.063		.156
Withdrawn/depressed	Pre-intervention	53-67	59.00 (7.21)	50-69	62.25 (8.73)	50-81	64.00 (11.64)	50-64	56.80 (5.54)
	Post-intervention	53-77	64.33 (12.06)	50-64	58.67 (7.57)	50-78	59.00 (12.92)	50-57	54.00 (3.00)
	Z		-1.342		-1.000		-1.461		-1.414
	p		.250		.500		.125		.250
Somatic complaints	Pre-intervention	50-58	55.33 (4.62)	57-73	64.25 (6.70)	50-71	63.80 (8.41)	50-62	52.40 (5.37)
	Post-intervention	50-78	65.00 (14.11)	50-67	58.00 (8.54)	50-67	59.00 (6.25)	50-62	54.80 (6.57)
	Z		-1.342		-.447		-1.604		-1.000
	p		.250		.500		.125		.500
Attention problems	Pre-intervention	51-69	60.00 (9.00)	50-64	57.00 (6.22)	50-62	57.60 (5.13)	54-75	62.40 (7.77)
	Post-intervention	50-87	66.00 (19.00)	50-60	55.67 (5.13)	50-62	55.80 (5.17)	50-64	57.20 (5.93)
	Z		-.816		-1.000		-1.342		-1.214
	p		.375		.500		.250		.156

Rule-breaking behaviour	Pre-intervention	50-66	56.33 (8.51)		50-66	58.75 (7.54)		50-70	60.80 (8.59)		50-68	54.20 (7.82)
	Post-intervention	50-72	58.33 (11.93)		50-55	51.67 (2.89)		53-66	59.80 (4.76)		50-66	55.00 (6.63)
	Z		-1.000			-1.000			-.271			-1.089
	p		.500			.500			.438			.250
Aggressive behaviour	Pre-intervention	50-72	57.33 (12.70)		50-68	60.75 (7.63)		50-66	62.00 (6.78)		53-69	62.20 (6.54)
	Post-intervention	50-73	58.00 (13.00)		50-60	53.33 (5.77)		53-67	62.60 (5.90)		50-70	56.20 (7.92)
	Z		-1.414			-1.342			-.552			-1.214
	p		.250			.250			.406			.156
Internalizing problems	Pre-intervention	45-67	55.00 (11.14)		48-76	64.00 (11.66)		37-78	65.20 (16.30)		52-70	60.80 (7.53)
	Post-intervention	45-86	65.00 (20.52)		38-64-	53.33 (13.61)		37-70	57.00 (13.69)		38-64	56.00 (10.49)
	Z		-1.342			1.604			-1.826			-.944
	p		.250			.125			.063			.219
Externalizing problems	Pre-intervention	41-71	53.33 (15.70)		41-68	58.75 (12.18)		43-69	10.80 (10.47)		53-69	61.20 (6.65)
	Post-intervention	41-74	55.33 (16.92)		41-59	47.67 (9.87)		57-67	63.00 (4.64)		43-70	54.40 (9.84)
	Z		-1.414			-1.342			-.406			-1.214
	p		.250			.250			.375			.156
ADHD problems	Pre-intervention	50-66	58.67 (8.08)		50-64	57.25 (5.74)		50-64	58.60 (5.64)		55-87	66.20 (12.28)
	Post-intervention	50-73	61.00 (11.53)		50-59	55.67 (4.93)		51-60	56.20 (3.70)		51-63	56.60 (5.03)
	Z		-1.000			-1.000			-1.761			-1.753
			.500			.500			.063			.063

Note. CBCL = Child Behaviour Checklist. ADHD = Attention Deficit Hyperactive Disorder.

APPENDIX DD

Table DD1

Subtests Making up Neuropsychological Composites at Post-test: Between-group Comparisons for TBI Intervention Group and Control groups (N = 19)

	Groups												Test statistics		
	TBI Intervention Group (*n* = 5)			TBI Art Group (*n* = 4)			TBI Control Group (*n* = 5)			ADHD Intervention Group (*n* = 5)					
Composite variable	*n*	*M(SD*	*Range*	*n*	*M(SD)*	Range	n	*M(SD)*	*Range*	n	*M(SD)*	Range	*F/H*	*p*	*r*
Sustained attention (α = .71)															
Score	5	7.20 (1.92)	5-10	4	7.00 (2.94)	4-11	4	10.00 (1.41)	9-12	5	6.40 (3.29)	1-9	1.68	.216	.27
Numbers Forwards	5	7.00 (3.67)	4-13	4	6.75 (2.06)	4-9	5	6.80 (3.27)	3-10	5	9.00 (2.00)	6-11	.68	.578	.12
Same World	5	6.00 (.71)	5-7	4	4.75 (3.78)	1-8	5	4.80 (3.11)	1-8	5	6.20 (3.35)	1-10	.41[a]	.946	.37
INN Time	5	4.40 (3.98)	1-10	4	5.50 (3.41)	1-9	5	5.60 (4.78)	1-11	5	8.60 (4.62)	1-13	.88	.473	.15
INN Combined SS	5	3.20 (2.59)	1-6	4	6.25 (3.86)	1-10	5	5.60 (4.98)	1-13	5	7.40 (5.32)	1-15	2.03[a]	.593	.06
Omissions	5	91.15 (32.75)	49.48-124.76	4	95.45 (45.95)	63.36-161.71	4	77.86 (15.53)	54.88-93.96	5	72.00 (31.37)	47.42-122.02	.54	.661	.10
Commissions	5	47.81 (4.67)	40.96-53.81	4	37.35 (11.36)	26.95 - 47.96	4	44.80 (9.96)	28.09-52.39	5	45.40 (12.07)	25.23-55.87	.90	.463	.15
Hit RT	5	70.72 (11.53)	56.27-85.27	4	82.81 (14.21)	64.61-98.64	4	71.20 (5.98)	64.11-76.64	5	73.47 (14.71)	54.47-93.45	.77	.529	.13
Hit RT SE	5	74.38 (11.11)	56.92-84.58	4	75.56 (11.26)	65.04-91.43	4	69.95 (7.65)	61.89-79.47	5	65.82 (10.62)	56.93-80.91	.86	.483	.15
Hit RT ISI Change	5	79.31 (20.22)	59.36-110.55	4	79.05 (22.23)	51.21-103.74	4	68.13 (15.52)	51.29-85.86	5	63.50 (17.57)	44.22-89.53	.85	.489	.15

Hit SE ISI Change	5	64.72 (8.19)	55.93-78.17	4	62.10 (8.99)	49.50-70.83	4	59.66 (6.44)	51.10-67.38	5	58.85 (5.48)	51.95-64.79	.66	.592	.12
Variability	5	68.45 (10.85)	54.74-84.23	4	68.17 (9.77)	59.71-82.27	4	63.96 (8.55)	53.03-72.46	5	62.38 (7.08)	53.08-69.69	.50	.689	.09
Detectability	5	53.27 (3.13)	49.32-57.06	4	42.37 (11.81)	27.10-55.74	4	44.49 (14.90)	28.55-62.41	5	52.47 (11.97)	31.48-60.79	3.97 [a]	.265 [b]	.18
Selective attention (α = .72)															
Sky Search targets found	5	7.60 (5.41)	3-16	4	8.50 (2.65)	5-11	4	11.50 (3.00)	8-14	4	11.00 (4.58)	4-16	.92	.457	.17
Sky Search time-per-target	5	5.60 (4.34)	1-11	4	2.75 (1.26)	1-4	4	3.25 (3.20)	1-8	5	6.20 (4.21)	2-13	2.96 [a]	.422	
Sky Search attention score	5	5.80 (4.87)	1-13	4	3.25 (1.71)	1-5	4	4.25 (3.30)	1-8	5	6.20 (4.15)	1-12	.57	.646	.11
Attentional control															
Opposite worlds	5	4.40 (4.34)	2-12	4	3.25 (2.63)	1-6	5	4.60 (3.36)	1-8	5	5.80 (3.83)	1-11	1.13[a]	.791	.19
Divided attention															
Sky Search DT	5	1.60 (1.34)	1-4	4	4.25 (4.27)	1-10	4	2.00 (2.00)	1-5	5	2.00 (2.34)	1-6	1.71[a]	.706	.12
Inhibition (α = .84)															
INI Total CT	5	8.20 (3.96)	5-13	4	8.25 (2.99)	5-12	5	8.60 (4.33)	3-13	5	10.20 (3.77)	4-14	.29	.830	.06
INI Combined SS	5	5.80 (2.28)	2-8	4	5.25 (2.50)	2-8	5	8.00 (4.30)	2-13	5	10.20 (3.90)	5-15	2.07	.147	.29
Working memory															
Numbers backwards	4	7.25 (2.22)	4-9	4	7.50 (.58)	7-8	5	8.00 (4.30)	2-13	5	10.40 (4.45)	5-16	1.22[a]	.774	.17
Numbers backwards	4	7.25 (2.22)	4-9	4	7.50 (.58)	7-8	5	8.00 (4.30)	2-13	5	10.40 (4.45)	5-16	1.22[a]	.774	.17

Verbal memory (α = .93)														
WL Learning	5	4.20 (3.11)	1-8	4	6.50 (.58)	6-7	5	6.60 (4.62)	3-13	4	12.74 (3.78)	9-16	7.93[a]	.033*	.42
WL Delayed	5	6.80 (.45)	6-7	4	7.25 (1.26)	6-9	5	8.40 (5.23)	3-14	4	14.25 (1.89)	13-17	6.29[a]	.089	.31
WL Delayed Recognition	5	7.00 (1.87)	4-9	4	4.50 (2.38)	3-8	5	6.40 (4.39)	2-13	4	12.00 (1.16)	11-13	8.23[a]	.027*	.44
Visual memory (α = .87)	5	7.20 (3.56)	4-12	4	10.25 (1.89)	9-13	5	9.60 (3.91)	3-13	4	12.75 (2.63)	9-15	2.26	.126	.27
DL Learning	5	9.40 (2.19)	8-13	4	11.00 (1.41)	9-12	5	10.40 (2.30)	7-13	4	12.75 (.96)	12-14	5.52[a]	.133	.26
DL Long Delay	5	7.60 (3.51)	4-13	4	10.50 (3.42)	7-15	5	10.40 (4.16)	4-16	4	12.50 (2.89)	10-15	4.46[a]	.222	.24
DL Total Score	5	7.20 (3.56)	4-12	4	10.25 (1.89)	9-13	5	9.60 (3.91)	3-13	4	12.75 (2.63)	9-15	2.26	.126	.27

Note. [a]Kruskal Wallis H statistic. [b] Exact level of significant not given, only asymptotic. The *r* value here is an estimate of effect size. Composites were calculated using z-scores but domains with only one test (Attentional control, divided attention, working memory) were calculated using scaled scores. INN = Inhibition-Naming; CT = Completion Time; SS = Scaled Score; RT = Reaction Time; SE = Standard Error; ISI = Inter-stimulus Interval; DT = Dual Task; INI = Inhibition-Inhibition; WL = Word List; DL = Dot Locations. **p* = <.05.

APPENDIX EE

Table EE1

Between-group Analyses for Neuropsychological Subtests at Post-test: TBI Intervention Group vs. Control Groups (N = 19)

	Groups												Test statistics		
	TBI Intervention Group (*n* = 5)			TBI Art Group (*n* = 4)			TBI Control Group (*n* = 5)			ADHD Intervention Group (*n* = 5)					
	M(SD)	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*F/H*	*p*	*r*
Attention and Concentration															
Sky Search targets found	7.60 (5.41)	3-16		8.50 (2.65)	5-11		11.50 (3.00)[b]	8-14		11.00 (4.58)	4-16		.92	.457	.17
Sky Search time-per-target	5.60 (4.34)	1-11	10.60	2.75 (1.26)	1-4	7.38	3.25 (3.20)[b]	1-8	7.00	6.20 (4.21)	2-13	12.10	2.96[a]	.422	.05
Sky Search attention score	5.80 (4.87)	1-13		3.25 (1.71)	1-5		4.25 (3.30)[b]	1-8		6.20 (4.15)	1-12		.57	.646	.11
Score	7.20 (1.92)	5-10		7.00 (2.94)	4-11		10.00 (1.41)[b]	9-12		6.40 (3.29)	1-9		1.68	.216	.27
Sky Search DT	1.60 (1.34)	1-4	8.40	4.25 (4.27)	1-10	11.88	2.00 (2.00)	1-5	9.13	2.00 (2.34)	1-6	9.00	1.71[a]	.706	.12
Same World	6.00 (.71)	5-7	9.60	4.75 (3.78)	1-8	9.88	4.80 (3.11)	1-8	9.20	6.20 (3.35)	1-10	11.30	.41[a]	.946	.37
Opposite World	4.40 (4.34)	2-12	9.90	3.25 (2.63)	1-6	7.75	4.60 (3.36)	1-8	10.20	5.80 (3.83)	1-11	11.70	1.13[a]	.791	.19
Omissions	91.15 (32.75)	49.48-124.76		95.45 (45.95)	63.36-161.71		77.86 (15.53)	54.88-93.96		72.00 (31.37)	47.42-122.02		.54	.661	.10
Commissions	47.81 (4.67)	40.96-53.81		37.35 (11.36)	26.95 - 47.96		44.80 (9.96)	28.09-52.39		45.40 (12.07)	25.23-55.87		.90	.463	.15
Hit RT	70.72 (11.53)	56.27-85.27		82.81 (14.21)	64.61-98.64		71.20 (5.98)	64.11-76.64		73.47 (14.71)	54.47-93.45		.77	.529	.13
Hit RT SE	74.38 (11.11)	56.92-84.58		75.56 (11.26)	65.04-91.43		69.95 (7.65)	61.89-79.47		65.82 (10.62)	56.93-80.91		.86	.483	.15

Variability	68.45 (10.85)	54.74-84.23		68.17 (9.77)	59.71-82.27		63.96 (8.55)	53.03-72.46		62.38 (7.08)	53.08-69.69		.50	.689	.09
Detectability	53.27 (3.13)	49.32-57.06	11.70	42.37 (11.81)	27.10-55.74	6.25	44.49 (14.90)	28.55-62.41	8.40	52.47 (11.97)	31.48-60.79	12.90	3.97[a]	.265	.18
Perseverations	81.65 (22.35)	51.86-106.62	12.00	73.95 (25.32)	52.60-109.20	10.75	75.31 (27.26)	44.92-114.96	10.50	67.84 (40.64)	44.92-140.28	6.90	2.26[a]	.520[b]	.03
Hit RT Block Change	62.71 (17.63)	40.45-83.22		47.76 (17.22)	34.92-72.79		52.98 (20.29)	27.54-72.26		51.28 (6.78)	44.34-60.85		.73	.551	.13
Hit SE Block Change	54.54 (13.16)	37.98-69.93		53.34 (10.26)	44.02-67.25		52.54 (10.83)	40.83-64.44		53.05 (7.48)	46.80-64.92		.03	.992	.01
Hit RT ISI Change	79.31 (20.22)	59.36-110.55		79.05 (22.23)	51.21-103.74		68.13 (15.52)	51.29-85.86		63.50 (17.57)	44.22-89.53		.85	.489	.15
Hit SE ISI Change	64.72 (8.19)	55.93-78.17		62.10 (8.99)	49.50-70.83		59.66 (6.44)	51.10-67.38		58.85 (5.48)	51.95-64.79		.66	.592	.12
Confidence index	88.38 (19.08)	55.93-99.90	11.40	80.60 (22.29)	60.81-99.90	10.25	88.37 (14.23)	67.09-99.90	11.00	71.29 (26.65)	46.04-99.90	7.40	1.72[a]	.658	.09
Number Forwards	7.00 (3.67)	4-13		6.75 (2.06)	4-9		6.80 (3.27)	3-10		9.00 (2.00)	6-11		.68	.578	.12
Numbers Backwards	7.25 (2.22)[b]	4-9	8.75	7.50 (.58)	7-8	8.00	8.00 (4.30)	2-13	9.20	10.40 (4.45)	5-16	11.60	1.22[a]	.774	.18
Numbers Total	7.25 (3.78)[b]	3-12		6.25 (1.26)	5-8		6.40 (4.62)	1-12		9.40 (3.51)	4-13		.78	.525	.14
INN Total CT	4.40 (3.98)	1-10		5.50 (3.41)	1-9		5.60 (4.78)	1-11		8.60 (4.62)	1-13		.88	.473	.15

INN Combined SS	3.20 (2.59)	1-6	7.80	6.25 (3.86)	1-10	6.50	5.60 (4.98)	1-13	11.00	7.40 (5.32)	1-15	14.00	2.03[a]	.593	.14
INI Total CT	8.20 (3.96)	5-13		8.25 (2.99)	5-12		8.60 (4.33)	3-13		10.20 (3.77)	4-14		.29	.830	.06
INI Combined SS	5.80 (2.28)	2-8		5.25 (2.50)	2-8		8.00 (4.30)	2-13		10.20 (3.90)	5-15		2.07	.147	.29
INN vs. INI Contrast SS	8.00 (1.73)	5-9	9.40	6.00 (1.41)	5-8	5.00	9.40 (2.88)	5-12	12.00	10.00 (3.67)	5-14	12.60	5.12[a]	.162	.28
Inhibition Total Errors	5.40 (2.61)	4-10	6.40	7.50 (.71)[c]	7-8	10.75	6.00 (4.55)[b]	1-12	7.88	8.20 (5.45)	1-14	10.20	2.16[a]	.582	.05
Memory															
DL Learning	7.20 (3.56)	4-12		10.25 (1.89)	9-13		9.60 (3.91)	3-13		12.75 (2.63)[b]	9-15		2.26	.126	.27
DL Short Delay	9.60 (2.61)	8-14	8.10	10.75 (2.87)	7-13	9.50	10.80 (2.78)	7-14	10.00	9.75 (5.97)[b]	1-14	10.63	.58[a]	.913	.32
DL Long Delay	9.40 (2.19)	8-13	6.40	11.00 (1.41)	9-12	9.50	10.40 (2.30)	7-13	8.60	12.75 (.96)[b]	12-14	14.50	5.52[a]	.133	.26
DL Total Score	7.60 (3.51)	4-13	5.70	10.50 (3.42)	7-15	10.00	10.40 (4.16)	4-16	10.10	12.50 (2.89)[b]	10-15	13.00	4.46[a]	.222	.24
WL Learning	4.20 (3.11)	1-8	5.80	6.50 (.58)	6-7	9.25	6.60 (4.62)	3-13	8.50	12.74 (3.78)[b]	9-16	15.63	7.93[a]	.033*	.51
WL Delayed	6.80 (.45)	6-7	7.60	7.25 (1.26)	6-9	8.25	8.40 (5.23)	3-14	7.80	14.25 (1.89)[b]	13-17	15.25	6.29[a]	.089	.32
WL Delayed Recognition	7.00 (1.87)	4-9	9.30	4.50 (2.38)	3-8	5.63	6.40 (4.39)	2-13	7.80	12.00 (1.16)[b]	11-13	15.75	8.23[a]	.027*	.53

Note. [a]Kruskal Wallis H statistic. [b] n = 4. [c] *n* = 2. The *r* value here is an estimate of effect size. CT = Completion time; DL = Dot Locations; DT = Dual Task; INN = Inhibition-Naming; INI = Inhibition-Inhibition; RT = Reaction Time; SE = Standard Error; SS = Scaled Score; WL = Word List.

APPENDIX FF

Table FF1

Between-group Analyses for BRIEF Teacher Report at Post-test: TBI Intervention Group vs. Control Groups (N = 16)

	Groups												Test statistics		
	TBI Intervention Group (n = 3)			TBI Art Group (n = 3)			TBI Control Group (n = 5)			ADHD Intervention Group (n = 5)					
BRIEF index	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*H*	*p*	*r*
Inhibit	53.00 (11.53)	44-66	7.50	49.33 (7.10)	43-57	5.17	62.20 (4.76)	56-69	11.20	55.60 (12.34)	43-71	8.40	3.23	.384	.08
Shift	63.33 (15.95)	50-81	8.83	52.00 (7.55)	44-59	5.50	60.40 (17.86)	43-89	8.20	64.20 (12.62)	51-83	10.40	2.03	.602	.07
Emotional Control	55.00 (14.00)	45-71	8.17	45.67 (3.79)	43-50	3.83	59.40 (15.44)	44-84	10.00	55.40 (10.02)	48-73	10.00	3.90	.289	.14
BRI	57.33 (14.74)	46-74	12.67	48.67 (6.11)	42-54	5.50	62.00 (10.2)	55-80	6.60	59.20 (10.83)	46-69	9.70	4.68	.204	.21
Initiate	76.33 (15.01)	59-85	12.50	54.33 (8.02)	46-62	3.83	56.80 (10.71)	44-72	6.40	61.80 (9.26)	63-71	11.00	4.64	.208	.20
Working memory	74.00 (13.45)	59-85	12.17	51.33 (8.62)	42-59	4.67	57.20 (10.21)	47-73	6.50	74.00 (13.45)	57-73	10.60	7.37	.042*	.43
Plan/organization	74.33 (15.54)	57-87	8.83	53.00 (9.85)	42-61	5.33	57.40 (10.21)	42-70	9.60	66.40 (6.19)	44-78	9.10	5.61	.126	.29
Org. of materials	53.33 (13.65)	44-69	7.83	46.33 (4.04)	42-50	5.33	55.60 (10.97)	42-69	9.20	58.60 (13.33)	49-76	10.10	2.08	.591	.06
Monitor	62.00 (14.00)	52-78	7.17	52.33 (13.05)	40-66	4.00	62.60 (7.77)	56-76	11.20	63.20 (11.93)	48-76	9.30	1.70	.672	.11
MI	70.33 (15.01)	55-85	11.33	51.33 (9.61)	41-60	4.33	58.80 (9.73)	49-74	7.20	65.60 (8.20)	54-74	10.60	4.72	.199	.21
GEC	73.33 (9.07)	65-83	12.83	50.33 (8.62)	41-58	3.33	63.80 (14.55)	53-89	8.40	64.20 (8.73)	52-72	9.10	6.13	.095	.33

Note. BRIEF = Behaviour Rating Inventory of Executive Function. BRI = Behaviour Recognition Index, Org. = Organization, MI = Metacognition Index, GEC = Global Executive Composite. The *r* value here is an estimate of effect size. *$p < .05$.

APPENDIX GG

Table GG1

Between-group Analyses for BRIEF Parent Report at Post-test: TBI Intervention Group vs. Control Groups (N = 19)

	Groups								Test statistics		
	TBI Intervention Group (n = 5)		TBI Art Group (n = 4)		TBI Control Group (n = 5)		ADHD Intervention Group (n = 5)				
BRIEF index	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*F/H*	*p*	*r*
Inhibit	51.20 (15.77)	36-75	47.25 (7.14)	40-57	55.60 (14.86)	40-71	62.60 (11.61)	49-73	1,.7	.356	.19
Shift	50.80 (9.68)	37-60	49.75 (5.32)	43-56	57.40 (14.78)	39-74	64.40 (13.74)	47-84	1.57	.239	.24
Emotional Control	50.00 (9.51)	40-61	59.25 (14.32)	45-78	53.40 (11.37)	36-67	62.80 (13.65)	43-73	1.09	.385	.18
BRI	50.40 (13.28)	35-66	46.50 (3.7)	44-52	55.80 (14.81)	36-72	64.60 (12.05)	44-75	4.25[a]	.236[b]	.17
Initiate	55.40 (7.16)	46-65	51.50 (6.56)	46-59	46.80 (9.42)	35-59	55.60 (11.15)	39-68	1.08	.387	.18
Working memory	60.80 (9.73)	50-73	56.25 (7.37)	48-65	53.40 (14.98)	39-72	60.20 (4.82)	55-65	1.56[a]	.669[b]	.10
Plan/organization	59.00 (11.47)	43-74	53.50 (1.29)	52-55	48.60 (7.93)	38-58	57.80 (11.88)	46-76	1.23	.332	.20
Org. of materials	51.60 (8.91)	40-63	50.50 (7.05)	43-57	46.20 (9.94)	34-61	58.60 (9.84)	46-72	1.58	.235	.24
Monitor	52.20 (7.33)	44-62	45.75 (2.36)	44-49	47.40 (14.64)	35-69	57.40 (14.48)	44-82	1.00	.418	.17
MI	57.00 (9.93)	44-70	52.00 (3.65)	48-56	48.60 (12.74)	35-65	59.80 (9.99)	50-75	1.25	.327	.20
GEC	55.00 (11.87)	40-70	50.25 (3.59)	47-55	51.80 (14.2)	35-69	62.40 (9.37)	52-75	1.18	.351	.19

Note. [a]Kruskal Wallis H statistic; For BRI, the mean rank for TBI Intervention Group = 8.00, TBI Art Group = 6.88, TBI Control Group = 10.70, and ADHD Intervention = 13.80. For Working Memory, the mean rank for TBI Intervention Group is 11.70, TBI Art Group = 8.75, TBI Control Group = 8.00, and ADHD Intervention Group = 11.30. [b]Exact level of significance not given, only asymptotic. The *r* value here is an estimate of effect size.

APPENDIX HH

Table HH1

Between-group Analyses for VABS-II Parent Report at Post-test: TBI Intervention Group vs. Control Groups (N =19)

	Groups								Test statistics		
	TBI Intervention Group (n = 5)		TBI Art Group (n = 4)		TBI Control Group (n = 5)		ADHD Intervention Group (n = 5)				
VABS-II	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*M(SD)*	Range	*F/H*	*p*	*r*
Communication	41.00 (11.64)	25-55	41.50 (8.39)	33-53	39.80 (13.81)	23-56	43.00 (9.43)	32-52	.07	.975	.01
Receptive	14.80 (4.76)	8-20	15.75 (2.63)	13-18	12.00 (3.74)	7-17	11.60 (2.70)	9-16	1.47	.262	.23
Expressive	14.80 (4.76)	7-19	12.50 (3.11)	10-17	15.40 (4.62)	10-20	18.20 (4.44)	13-23	1.32	.306	.21
Written	11.40 (2.97)	8-16	13.25 (5.50)	8-18	12.40 (5.64)	6-19	13.20 (3.27)	10-17	.58[a]	.914	.31
Daily Living Skills	43.40 (10.36)	34-61	38.25 (5.25)	31-43	41.20 (15.80)	23-58	49.40 (11.06)	33-64	.78	.526	.13
Personal	15.00 (3.24)	11-18	13.25 (5.50)	8-21	15.20 (6.38)	9-22	17.60 (5.18)	10-24	.54	.661	.10
Domestic	15.40 (2.97)	12-20	13.00 (1.16)	12-14	12.40 (4.51)	7-19	15.80 (2.86)	12-20	4.94[a]	.177	.21
Community	13.00 (7.14)	4-24	12.00 (2.16)	10-15	13.60 (6.19)	7-22	16.00 (3.39)	11-20	.49	.698	.09
Socialisation	42.80 (17.91)	24-71	40.50 (9.68)	29-49	43.40 (15.16)	28-62	48.00 (2.83)	45-51	.27	.844	.05
Interpersonal relationships	14.40 (6.47)	7-23	13.75 (3.59)	9-17	14.20 (5.63)	8-21	17.60 (1.67)	15-19	1.99[a]	.603	.06
Play and leisure time	12.60 (7.02)	5-24	13.00 (2.16)	10-15	13.80 (5.17)	8-21	14.00 (2.00)	12-17	.10	.961	.02
Coping skills	15.80 (4.82)	12-24	13.75 (5.91)	6-20	15.40 (5.60)	9-21	16.40 (1.95)	14-19	.25	.862	.05
Adaptive behaviour composite	74.20 (13.85)	59-95	88.75 (4.35)	83-93	94.80 (29.77)	63-133	91.20 (18.95)	61-110	1.05	.398	.17

Note. [a]Kruskal Wallis H statistic; For Written, the mean rank for TBI Intervention = 8.80, TBI Art Group = 10.88, TBI Control Group = 9.40, ADHD Intervention Group = 11.10; for Domestic, the mean rank for TBI Intervention = 12.10, TBI Art Group = 7.25, TBI Control Group = 6.90, ADHD Intervention Group = 13.20; for Interpersonal relationships, the mean rank for TBI Intervention = 9.30, TBI Art Group = 8.00, TBI Control Group = 9.40, ADHD Intervention Group = 12.900; The *r* value here is an estimate of effect size.

APPENDIX II

Table II1

Between-group Analyses for CBCL Teacher Report at Post-test: TBI Intervention Group vs. Control Groups (N = 16)

	Groups												Test statistics		
	TBI Intervention Group (*n* = 3)			TBI Art Group (*n* = 3)			TBI Control Group (*n* = 5)			ADHD Intervention Group (*n* = 5)					
CBCL syndrome profile	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*M(SD)*	Range	Mean rank	*H*	*p*	*r*
Anxious/depressed	62.00 (16.64)	50-81	8.67	54.00 (6.93)	50-62	5.67	58.80 (7.40)	50-66	9.20	60.00 (6.75)	50-68	9.40	1.40	.737	.16
Withdrawn/depressed	64.33 (12.06)	53-77	11.33	58.67 (7.57)	50-64	9.00	59.00 (12.92)	50-78	7.80	54.00 (3.00)	50-57	7.20	1.64	.679	.12
Somatic complaints	65.00 (14.11)	50-78	11,17	58.00 (8.54)	50-67	8,17	59.00 (6.25)	50-67	9,1	54.80 (6.57)	50-62	6,5	2.05	.588	.06
Attention problems	66.00 (19.00)	50-87	10.50	55.67 (5.13)	50-60	7.00	55.80 (5.17)	50-62	7.60	57.20 (5.93)	50-64	9.10	1.11	.801	.21
Rule-breaking behaviour	58.33 (11.93)	50-72	8.67	51.67 (2.89)	50-55	5.00	59.80 (4.76)	53-66	11.50	55.00 (6.63)	50-66	7.50	3.98	.276	.15
Aggressive behaviour	58.00 (13.00)	50-73	7.83	53.33 (5.77)	50-60	5.00	62.60 (5.90)	53-67	11.40	56.20 (7.92)	50-70	8.10	3.65	.325	.11
Internalizing problems	65.00 (20.52)	45-86	10.67	53.33 (13.61)	38-64	7.33	57.00 (13.69)	37-70	8.50	56.00 (10.49)	38-64	7.90	.89	.851	.26
Externalizing behaviour	55.33 (16.92)	41-74	7.67	47.67 (9.87)	41-59	5.17	63.00 (4.64)	57-67	11.70	54.40 (9.84)	43-70	7.80	3.96	.284	.15
ADHD problems	61.00 (11.53)	50-73	10.33	55.67 (4.93)	50-59	7.00	56.20 (3.70)	51-60	8.20	56.60 (5.03)	51-63	8.60	.77	.877	.29

Note: CBCL = Child Behaviour Checklist. ADHD = Attention Deficit Hyperactive Disorder. The *r* value here is an estimate of effect size.